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Distribution of American Research Funds

Clarence A. Mills

Laboratory for Experimental Medicine, University of Cincinnati

EQUITY AND WISDOM IN THE DISTRIBUTION of Federal research funds seem of paramount importance in the years ahead. That such funds should and will be made available in large amounts seems now to be widely accepted. The drying up of private bequests has left no alternative. If our universities and research institutions are to continue fostering the American investigative spirit which has been so largely responsible for our past achievements, new sources of financial support must be found. Since the welfare of the whole country is directly concerned, it seems most appropriate that such aid be derived from Federal funds.

There exists no evidence that native intelligence is better in one part of the United States than in another. Opportunities for the blossoming of exceptional ability do vary sharply from region to region, however—a variation which is correlated closely with the availability of institutions of higher learning. This is particularly true of the development of young scientists; there is no way in which promising individuals can be discovered except by bringing them into close contact with science subjects. Encouragement of research in America must thus mean the greatest possible broadening of the base of student exposure, as well as the broadest possible support of promising individuals once they have been found.

In order that future funds may be distributed to the best advantage of the country as a whole, I have sought information from past distributional techniques in the field of medical research, with which I have been most closely in contact during the past 30 years. My findings bring out very disturbing inequalities in the granting of such funds—inequalities so pernicious in end results as to indicate the need for an entirely new basis of action with the large Federal outlays in future years.

Physicians, and particularly medical scientists, have usually been credited with an altruism second only to that of the clergy. Almost all medical research funds available for distribution were, therefore, dealt out only on the advice of committees of these men. Today we must admit that too many such individuals seem incapable of acting without harmful bias, that institutional representation on such committees too often means top recipient rating for funds to be distributed. This is by no means an idle accusation; it is borne out only too well by the facts which follow.

Medical Research Funds Studied: Methods

Because of the long-term dominance exerted over medical research by the older institutions of the eastern seaboard (Harvard, Yale, Johns Hopkins, Columbia, Pennsylvania), the following northeastern states have been set off in a group by themselves: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, and the District of Columbia. Although this small corner of the United States contains less than 30% of the country's total population, it gets 50–80% of all research funds.

Sources of funds for medical research, the geographical distribution of which could be ascertained, included: American Cancer Society, International Cancer Research Foundation, Commonwealth Fund, Life Insurance Medical Research Fund, Josiah Macy, Jr. Foundation, John and Mary R. Markle Foundation, National Foundation for Infantile Paralysis, National Research Council, Ella Sachs Plotz Foundation, Rockefeller Foundation, and U. S. Public Health Service.

American Cancer Society. Of the $14,138,897 raised by this Society during 1945 and 1946 by public subscription all over the country, only 39.5% was contributed by the northeastern states listed above; but in the distribution of these funds for research purposes up to February of 1947, this same northeastern section received *66.7%* of the total. The remainder of the country, which contained over 70% of the total population and contributed 60.5% of the funds, received only *33.3%* of the research money distributed. Of the research fellowships supported by these funds during this period, *34* were for work at institutions in the northeastern section and *only 14* for work in the remainder of the country.

Let us glance now at the membership of the Committee on Growth of the National Research Council, which handled the allocation of these research grants and fellowships. Before July 1, 1946, *10* of its members held posts in institutions of the northeastern section and *only 2* elsewhere; since July 1, 1946, the proportions have been *16* and *3*. Similar disproportion exists in its associated Research Panels set up for channeling requests for funds: *53* from the Northeast against *24* from other parts of the country up to July 1, 1946, and since then, *68* against *36*. *Four* northeastern institutions with representation on the

Committee (Harvard, Johns Hopkins, Yale, and Columbia) received *29% of the total distribution* and 21% of the research fellows, while the best any top four institutions not so represented could do was only 11% and 10%, respectively. *Over half of all research allocations* and 63% of the research fellows went to institutions represented on the Committee on Growth (with its present 19 members).

National Research Council (1941–42 Annual Report). Membership on the Council in 1941–42 included *174* from the northeastern section and only *44* from the remainder of the United States! Its Medical Fellowship Board in 1944 had 11 members from the Northeast and 10 otherwise, while its Fellowship Board in the Biological Sciences had 32 and 23, respectively, and the Board in Physics, Chemistry, and Mathematics, 23 and 13.

In the NRC summary of activities from 1919 through 1944, we find that 276 Medical Fellowships were granted to U. S. workers—146 to men located in the small northeastern section and 130 to persons from the remainder of the country. Places chosen for the work of these Fellows, however, were even more disproportionate: 190 in the Northeast and only 90 elsewhere. (The discrepancy between 276 fellowships and 280 places of work is due to the fact that some men worked in more than one institution and to an imbalance between foreign students coming into this country and U.S.A. workers going abroad.) The net result of NRC activities from 1919 to 1944 was the awarding to 70% of the country's population of only 47% of the Medical Fellowships by place of origin and only 32% by place of work. Choice of place of work was usually left to the fellowship recipient. However, it is not surprising that so many of those from the "provinces" chose to work in the northeastern area when their home states fare so poorly in the distribution of working funds.

The northeastern Big Four (Harvard, Yale, Columbia, and Johns Hopkins), with heavy representation on the Medical Fellowship Board, were awarded 53% of all Medical Fellows (75% of all who chose to work in the northeastern area). The top midwestern four with heaviest Board representation received only 16% of the U. S. total, but this represented 49% of all workers not locating in the northeastern area. Harvard alone got 26% of the total number of fellowship workers and 49% of all locating in the northeastern area.

Rockefeller Foundation. In its appropriations of 1944, 1945, and 1946 for the support of medical teaching and research and for research in experimental biology, the Foundation awarded 77% of the U. S. total to teaching and research institutions in the northeastern area.

John and Mary R. Markle Foundation. Of the payments made in 1944, 1945, and 1946 for medical research grants in the United States, 58% were to institutions in the northeastern areas, 42% elsewhere.

Commonwealth Fund. Over the 5-year period, 1942–46, this Fund granted 74% of its U. S. medical research funds to institutions in the northeastern area and only 26% elsewhere.

International Cancer Research Foundation. The *Report of Activities* for 1943 indicates that 18 grants (69% of U. S. total) were made to workers in the northeastern area and 8 (31%) to workers elsewhere in the country. Of the 24 U. S. members of the Advisory Trustees, 22 (92%) are located in the northeastern area and 2 (8%) elsewhere.

Josiah Macy, Jr. Foundation. Of the grants for medical research in the United States during the 5-year period, 1937–41, 81% went to the northeastern area and only 19% elsewhere.

Ella Sachs Plotz Foundation. During the 5 years 1941, 1942, 1944, 1945, 1946, 48 grants (54%) were made to northeastern institutions or workers and 41 (46%) elsewhere in the United States.

Life Insurance Medical Research Fund. This recent addition to the medical research funds has a Medical Advisory Committee of 8 members, 5 located in the northeastern area and 3 elsewhere. Two committee members are from Harvard, 2 from Yale, and 1 each from Columbia, Vanderbilt, Minnesota, and Southern California Universities. Harvard received 16.5% of the funds distributed; Yale, 9.4%; and Columbia, 7.0%—*a total of 33%* thus going to these three institutions with top rating as recipients. Five institutions in the Northeast received a total of 43% of all funds distributed, while only 20% went to the luckiest 5 elsewhere. The Northeast received 51.3% of all funds, 48.7% going to the remainder of the country.

Similar inequality occurred in the distribution of Fellowships granted by this Fund. Sixteen Fellowships were granted to workers in the northeastern area, 22 to men elsewhere; but 22 spent their year working in northeastern institutions and only 16 in institutions elsewhere in the country—a net loss of 6 out of 22 young scientists from the West. Harvard received 16% of the Fellows for their year's work; Yale, 11%; and Columbia, 5%—a total of 32% of all Fellows thus going to work in these three institutions.

National Foundation for Infantile Paralysis. Annual nationwide money-raising campaigns provide funds for distribution by this Foundation, and, for once, less than half of the funds (48.7%) went to the northeastern area with its 29.7% of the total U. S. population. In 1946 its General Advisory Committee

consisted of 6 members from institutions in the northeastern area and 7 from institutions elsewhere in the United States; the "Committee on Virus Research," 3 and 5, respectively; and the "Committee on Research for Prevention and Treatment of Aftereffects," 4 and 13, respectively. Taking all the Foundation's advisory committees for the whole 9-year period (1938–47), there were 21 members from the northeastern area and 28 from the remainder of the country. This represents the most equitable geographic distribution of membership thus far encountered in committees dictating the disbursement of research funds.

With this more equitable distribution of committee membership, however, there still remained the very strong tendency for research grants to go to institutions with committee representation. From 1938 to 1947 there were 18 universities, 5 hospitals without medical school affiliation, 4 public health agencies, and 1 research institute represented on the Foundation's advisory committees, and in every one of these years the lion's share of disbursements went to the home institutions of these committee members (over 90% in the year 1941–42). During the 9 years, *75% of all research funds* went to institutions with committee representation, leaving only the morsel of 25% for all other research institutions in the country. As usual, Harvard, Yale, and Johns Hopkins were well to the top of the recipient list, being 3 of the top 5. The Universities of Michigan and Minnesota, both with committee representation, were the other two lucky recipients among the top 5. *Twelve of the country's institutions received 77% of all research funds distributed during this 9-year period. Eight universities with committee representation took for themselves 67% of all research funds distributed.*

Several committee members took nothing for their home institutions and two, only small single grants. One fair-sized grant (and only one) was made to an institution during the only year it had committee representation. The author's own university was doing quite well each year until it lost its committee representation by death.

U. S. Public Health Service. The Service's report of roughly $2,000,000 in grants approved March 26, 1946, revealed fairly equitable geographical distribution of funds—only 38% to the northeastern area with 30% of the population. Membership on the National Advisory Health Council, which recommends the distribution of these funds, is composed of 14 members: 4 from the USPHS, 2 each from Harvard, Columbia, and the University of Illinois, and 1 each from the Universities of Wisconsin, Michigan, California, and Tulane University in New Orleans.

Here again, however, the evils of committee representation show up clearly. Seven institutions with committee representation were among the 13 highest on the recipient list, these 13 receiving 47% of all research funds distributed. The 6 highest on the list received 31% of the total. The 2 northeastern institutions with committee representation received 23% of all funds allocated to that section, while 22% of funds allocated to the remainder of the country went to the other 5 represented on the Committee. Harvard, Columbia, and Johns Hopkins were, as usual, among the country's top 6 recipients.

Discussion

"For unto everyone that hath shall be given and he shall have abundance; but from him that hath not shall be taken away even that which he hath."

Present evidence points clearly to the dominant role membership on disbursing committees plays in the acquisition of research funds. From high places to low this devastating tendency holds sway. Even with the author's local section of the American Cancer Society, the first thousands of dollars locally collected for cancer research were taken by committee members: requests from researchers not on the committee would be cared for later if sufficient funds became available.

The obvious weakness of present distributional methods is that individual investigators are often the most biased in their appraisal of research proposals. Surely the projects they are working on seem most important to them; if not, they would not be so engaged. This weakness is of such basic significance today that it would almost seem imperative for disbursing committees to be prohibited from recommending grants to the institutions with committee representation. It seems clear that our top scientists are no more able to provide equitable distribution of funds at their disposal than are the politicians they have so castigated.

The author is well aware of the justification usually given for present distributional inequality—the larger research institutions receiving the lion's share of funds are best equipped for the prosecution of research. Such justification was very appropriate with the emergency needs for quick results during the war years. In peacetime, however, the basic need is not for quick results but rather for the broadest possible distribution of research opportunity to the country's whole population, especially where governmental funds or those collected from the whole country by popular subscription are concerned. There can be little real justification, for instance, for the New England and North Atlantic states with 30% of the country's population and contributing 39.5% of the cancer funds collected, receiving 66.7% of the research funds disbursed (by a committee on which they have a disproportionately large representation).

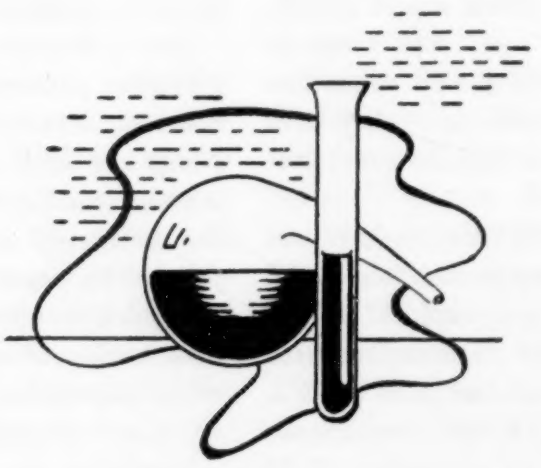
Most large funds have been contributed, directly or indirectly, by the country at large, even though their distribution as grants from New York City assumes a distinct appearance of largess when minor sums go west of the Alleghenies. For Washington, D. C., to follow a similar course with purely public funds—in amounts which will soon dwarf into insignificance previous distributions for research—would mean a tragedy of major proportions to the scientific development of the country as a whole. Until the proper technique for assuring unbiased distribution of such funds has been devised, the President seems justified in withholding his approval of any science-support program. Any state's use of its proper share of public funds for research should not be subject to dictation from eastern-dominated committees, else those of its residents who benefit will all too often be those with eastern friendships or connections.

The time has arrived when the West should shake off the stunting dominance of the northeastern seaboard in scientific matters, insisting on autonomy and a just share of public funds for its scientific development. So long as the rich eastern institutions secure the major part of funds disbursed, western institutions will perforce remain relatively pauperized and their most promising young scientists drift eastward, where working facilities are more propitious.

Corrective measures, however, must go beyond restoring a proper balance between East and West. The present tendency to benefit representation on disbursing committees must be broken. Scientists themselves have demonstrated a most unfortunate inability to act without bias in overseeing the distribution of funds in their own fields. No one believes that the politicians would themselves do any better, but theirs is the duty of so legislating that the proper end will be accomplished where public funds are concerned.

In the long run, the greatest good to the greatest number would probably be served by securing the distribution of Federal research funds—or those collected by public subscription—on a state-population basis. Perhaps the less wealthy states should even receive an added bonus to stimulate development, instead of being almost completely cut off as at present. Distribution within the state would present the next problem, for state committeemen would still be inclined to favor the institutions they know best—their own.

Obviously, distribution within a state must also be automatically determined. Whether it should be to educational institutions on the basis of numbers of science students enrolled or of numbers graduating with a science major is a matter for careful consideration and thorough discussion. At any rate, it seems imperative that the distributional mechanism be set up to be automatic down to the individual recipient institution. Even within each institution, the evils of committee membership should be guarded against, perhaps by prohibiting grants to a committee member's department in excess of the general department average in the college concerned, this provision to be broken only on unanimous approval by the whole committee. Whether the needed control within a state can be accomplished by Congressional action is another matter.



Obituary

Rudolf W. Glaser

1888-1947

In the death of Rudolf W. Glaser experimental biology lost one of its most original minds. Although he was trained at Harvard primarily as an entomologist, his active imagination and his readiness to take chances on problems that the less courageous would avoid as unpromising led him into difficult but rewarding borderline fields of study. As a result, no classification narrower than that of biologist can properly be applied to him.

Dr. Glaser's early work from 1913 to 1918, alone and with J. W. Chapman, established the filtrable virus nature of the etiological agents of the polyhedral diseases of lepidopterous larvae. The polyhedral diseases are of considerable economic importance, including as they do "grasserie" of silkworms and "wilt" of gypsy moth and tent caterpillars. Their investigation is perhaps even more important from the point of view of the comparative study of disease and disease-producing agents, and it was from this point of view that Glaser approached them. His interest in them continued throughout his later years, and he spent many hot summer weeks at the laboratory working with his silkworms while others were away vacationing. Glaser also isolated and described a number of bacterial species producing disease in flies, grasshoppers, and other insects. He was able to demonstrate acquired immunity and the presence of antibodies in insects.

These studies aroused an interest in the intracellular symbionts of insects—microorganisms so well adapted to their host that they not only fail to do it any harm but also are essential to its normal development. He succeeded in cultivating *in vitro* the intracellular symbionts of roaches, and in recent work showed that the symbionts are required for the maturation of the ovaries of their host.

The necessity for rearing experimental insects under controlled conditions led to several valuable investigations of breeding techniques and of the nutritional needs of such insects as the stable fly and the house fly. In the 1920s he anticipated more modern work on insect nutrition and postulated that insects which appeared to require living microorganisms could be reared free from them if furnished with the appropriate dietary factors.

In 1929 Glaser sought to propagate filtrable viruses in pure cultures of free-living protozoa. He found that the so-called pure cultures of free-living protozoa described up to that time were contaminated with many different kinds of bacteria. He therefore had to turn his attention first to obtaining really pure cultures. In this he was successful, not only with protozoa of less exacting nutritional requirements but eventually with *Paramecium* as well. He was not able to demonstrate virus multiplication in any of these cultures, but the work proved fruitful in that it helped to introduce the study of the growth requirements of ciliate protozoa and also turned out to be applicable in the cultivation of certain insects and nematodes.

Glaser and H. Fox in 1930 reported the discovery of a nematode parasite of the Japanese beetle, at that time already one of the most devastating insect pests in the eastern United States. The use of parasites for the control of noxious insects is a well-established procedure. Ordinarily one has to rear in the laboratory large numbers of the host insect for use, in turn, for the rearing of the parasites. But Glaser developed ways of culturing *Neoaplectana glaseri* Steiner of the Japanese beetle in nutrient media. In this he accomplished for the first time the cultivation of a parasitic nematode apart from a living host and at the same time provided a method for producing the economically important worm in literally unlimited numbers. Through the interest and cooperation of the Bureau of Plant Industry of the New Jersey Department of Agriculture his methods were adapted for the rapid dissemination of the nematodes over large areas. Studies in regions where the nematode was introduced have shown it to be a major factor in controlling the Japanese beetle.

The successful cultivation of a nematode parasite of an insect encouraged Glaser to attempt, in collaboration with N. R. Stoll, the still more difficult task of cultivating a nematode parasite of a vertebrate. In this they partially succeeded, when they obtained *in vitro* the development of the sheep stomach worm, *Haemonchus contortus,* through its early parasitic stages.

It is evident that all these varied fields of endeavor bore in one way or another on the fundamental problem of the physiological relationships between disease-producing agents and their hosts. In his lifetime devoted to research, Glaser contributed significantly toward the ultimate understanding of these relationships.

Dr. Glaser's attitude toward his work was free from sham and pretense. The prospects of financial or pro-

fessional reward did not influence his mode of work or his choice of problem. He chose problems because he wanted to know the answers. His friends will always remember him best for his deep sympathy and understanding, his lively sense of humor, and his inability to take himself or others too seriously.

WM. TRAGER
The Rockefeller Institute for Medical Research

Association Affairs

AAAS Journals

Members are advised that the February 6 issue of *Science* and the February issue of *The Scientific Monthly* will be the last sent to those who have not paid their dues for 1948. Because of high printing costs, free copies cannot be sent beyond a reasonable period. Remittances of dues should be forwarded promptly to insure continuity of receipt of the journals.

During the year 1947 the editorial staff of the Association worked on plans for improving the physical appearance and layout of the journals. Recommendations were made to the Publications Committee, and approval of the Executive Committee was secured to proceed with the plans formulated.

Beginning with the January 2, 1948, issue, *Science* has had a separate cover of heavier stock plus the new design and use of color. The use of heavier stock was dictated by the necessity of providing better carriage through the mails.

In the plans for physical improvement, the Association was fortunate in securing aid from the Bausch & Lomb Optical Company. An artist was commissioned by Bausch & Lomb to submit designs for the cover and suggestions for improvements in the typography of the Table of Contents page. The staff of the Association held several conferences with the artist, and the present design is the result. The interested assistance of the Bausch & Lomb organization has been acknowledged through the appropriate officers of the Association.

Further improvements will be sought continuously for both publications of the Association. At the meetings of the Association's Publications and Executive Committees in Chicago, the publication staff was directed to proceed as soon as possible to make both journals the same size. The experience of other societies publishing more than one journal was taken into consideration. In certain cases, scientific societies have achieved reductions of almost 25% in publication costs of their journals by such a standardization. Therefore, beginning with the next volume, *The Scientific Monthly*'s page size will be made identical with that now used in *Science*.

Section on Anthropology (H)

Section H held four sessions in the two opening days of the 114th meeting of the AAAS. One of these was a joint session with the Society for Research in Child Development, and another was in collaboration with the Linguistic Society of America. A new sound film, in color, showing the life of the Navajo Indians of New Mexico and Arizona, was presented with the cooperation of the American Museum of Natural History. All sessions were well attended and discussion was lively.

Following the previous practice of Section H, those papers were selected for presentation which seemed best to exemplify cross-disciplinary studies. In anthropology, these take two forms: (1) studies which combine two or more of the recognized branches of anthropology—archaeology, ethnology or cultural anthropology, linguistics, and physical anthropology; and (2) studies which cross into other disciplines or sciences. The high point of the former type was the dinner address by Wilson D. Wallis, vice-president of the AAAS, in which he critically analyzed recent reconstructions in physical anthropology according to standards laid down by techniques and methods of the other branches of anthropology. Volney Jones, of the University of Michigan, made an interesting contribution bringing botany and archaeology together. The cross-disciplinary paper which started the most discussion was probably that by Dorothy D. Lee, of Vassar College, in which she questioned the validity of the concept of basic needs as used today by both anthropologists and psychologists. This has important theoretical bearing on both sciences. Indeed, the trend in all the sessions seemed to be toward implications of a theoretical nature. A better trend could hardly be noted in this era of scientific stocktaking. (MARIAN W. SMITH, *Secretary*.)

Symposium on Industrial Processes (Section C)

The papers presented at this symposium, which was held on the afternoon of December 26, 1947, in Chicago, dealt with some of the research developments at the industrial laboratories represented by the five speakers. After the opening remarks by Charles D. Hurd, chairman, H. J. Hagemeyer, of Tennessee Eastman Corporation, presented new reactions of ketene. Of particular interest was the production of β-lactones at 10° by reaction of ketene with aldehydes or ketones in the presence of zinc chloride catalyst. Various aspects of the chemistry of thionyl chloride were presented by Alphonse Pechukas, of Pittsburgh Plate Glass Company. The merits of the syntheses using sulfur trioxide and sulfur chloride (SCl_2) or sulfur dioxide and chlorinating agents (such as SCl_2, PCl_5, SO_2Cl_2, PCl_3, $COCl_2$, CCl_4) were presented, together with the industrial process: $SO_2 + SCl_2 + Cl_2 \rightarrow 2\ SOCl_2 + 63$ kcal. The last reaction is carried out at 200° over a carbon catalyst.

Recent advances in drying oil and fatty acid technology were outlined by Ralph H. Manley, of General Mills. Some interesting developments in the field of plastics were mentioned. Jerome Martin, of Commercial Solvents Corporation, spoke on some recent developments in antibiotics, especially referring to streptothrycin, penicillin, and bacitracin. Streptothrycin, once seemingly promising, was abandoned because of its poisonous nature. Data on the remarkable stability of the crystalline potassium salt of penicillin G were presented. Attention was called to the fact that in dollar volume of sales, penicillin is now exceeded in the pure chemicals list only by sucrose, methane, and ethanol. The 20 tons of penicillin representing the present annual production sell for $120,000,000. Butadiene dextrose and methanol are next in line.

Arthur L. Fox and S. R. Buc, of General Aniline and Film Corporation, described interesting experiments designed for the synthesis of very large conjugated ring systems. (CHARLES D. HURD, *Chairman.*)

Symposium on Antibiotics (Section Nm)

It is prudent during the evolution of a rapidly developing discipline to pause frequently to review the past, scrutinize the present, and plan for the future. The symposium on antibiotics, organized by the officers of Section Nm (Medical Sciences) for the Chicago meeting of the AAAS, appropriately provided just such an opportunity in connection with one of the outstanding triumphs of modern science.

Back in 1928, when Dr. Fleming saw colonies of bacteria disappear from his culture dishes because of the presence of a mold, he was merely observing a type of microbic action which had previously been noted and described in some detail—a laboratory curiosity. However, he proceeded purposefully to grow the mold and attempted to recover from the metabolic products the substance, designated penicillin, which was believed to be responsible for the unusual phenomenon. Crude extracts incorporated in culture media proved to be unusually effective in preventing the multiplication of some germs, and impure preparations gave encouraging clinical results. Nevertheless, the simultaneous accounts of the therapeutic action of the sulfanilamides held in abeyance general interest in Sir Alexander's discoveries because of the ease of synthesis. Following the initial waves of enthusiasm, the sulfanilamides proved to have definite limitations. This and the menace of war influenced Dr. Florey and his associates to reinvestigate the possibility of the isolation of penicillin. From test tube cultures their studies emerged as a type of cooperative industrial research and production totally unheard of before. Penicillin was made available for the alleviation of untold human suffering during the war years. In the postwar period extension of this method, with the enlistment of individuals trained in many branches of science, has introduced refinements enabling the use of 20,000-gallon fermenters and a monthly production in the United States alone of approximately 3,000 billion units—a remarkable achievement.

Penicillin, although relatively nontoxic for man, has a limited microbic spectrum. It is ineffective against such germs as the tubercle bacillus, the *Rickettsia*, the virus, and the protozoa. These forms account for a tremendous annual toll in human life. The challenge to discover antibiotics for the treatment of diseases caused by these agents is being accepted by an unusual group of ardent investigators. Streptomycin, bacitracin, subtilin, and several other compounds are now in commercial production.

The papers prepared for the symposium were grouped under four captions. The first program was devoted to contributions covering the industrial production of penicillin and streptomycin; the chemistry of streptomycin, especially the chemical structure; and the chemistry of subtilin. Antibiotics obtained from the tomato plant and from the Irish potato were discussed, but they, like many other promising agents, are toxic. The basidiomycetes were referred to as worthy of intensive study as potential sources of potent compounds. The session concluded with a very timely report on the recently discovered antirickettsial substance, chloromycetin.

The second meeting stressed the pharmacology and mode of action of antibiotics. More than a hundred have been described with little or no chemical relation-

ship. Unfortunately, the majority have no value. Antibiotics seem to owe their effectiveness to an interference with the vital enzyme systems of the susceptible organisms. Impure penicillin and streptomycin have been found to have greater value than the crystalline products in protecting animals against bacterial infection and intoxication. The enhancement factors in the amorphous preparations are as yet unidentified. Until they are isolated, there seems to be little reason to employ the apparently superior amorphous products in preference to large doses of the crystalline forms.

One of the first shortcomings of penicillin from *in vitro* studies, subsequently confirmed on *in vivo* observations, was the development of resistance by sensitive strains of organisms. Similar research with streptomycin revealed the tubercle bacillus to have an unusual capacity for developing fastness, an attribute which was retained after many serial passages of the bacillus on laboratory media or in animals. This phenomenon reached alarming proportions when it was found that sensitive cultures of the meningococcus could be induced to give rise to forms which actually required streptomycin for growth and multiplied best in high concentrations of the drug. Animals infected with such strains promptly succumbed following streptomycin therapy, while untreated control animals remained alive indefinitely. The seeming growth requirement for streptomycin has been produced in variants of a wide variety of genera and species of bacteria and is a most disturbing observation.

The advent of the antibiotics has completely revolutionized the treatment of the infectious diseases. Many maladies which were formerly scourges of mankind are now under control. The perfect drug has not as yet been discovered; hence, investigators should be encouraged to keep up the present avid search. In papers covering the clinical use of penicillin and streptomycin, repeated reference was made to the false sense of security engendered by reports of miraculous cures. The laity was warned against accepting extravagant claims for new substances and was apprised of the distinct limitations of antibiotic therapy. The greatest problem confronting the clinical use of the antibiotics is the production of resistant and antibiotic dependent disease agents. Combination therapy is under investigation to combat this trend.

In bringing the two-day symposium to a close, E. V. Cowdry postulated with some optimism that the answer to the cancer problem lay in the fields of antibiotics (*Science*, January 30, p. 101). (MALCOLM H. SOULE, *Secretary.*)

NEWS and Notes

Plans are gradually being formulated for the next meeting of the Association, to be held in Washington, D. C., September 13–17. The AAAS Centennial Policy Committee, pictured on this week's cover, held its most recent meeting in Association headquarters in Washington on January 24–25. The group includes: *left to right* (standing)—F. R. Moulton, administrative secretary; Wendell M. Stanley, Rockefeller Institute; Roger Williams, University of Texas; John M. Hutzel, assistant administrative secretary; (seated)—Harlow Shapley, Harvard University; Edmund W. Sinnott, Yale University; and E. U. Condon, National Bureau of Standards. James Gilluly, of the University of California at Los Angeles, also a member of the Committee, was unable to attend. *Science* will from time to time publish brief reports of plans for the Centennial Meeting. The first of these will appear in next week's issue.

About People

William L. Slate, director of the Connecticut Agricultural Experiment Station and vice-director of the Storrs Agricultural Experiment Station since 1923, retired on December 31. Director Slate began his career in Connecticut in 1913, when he joined the Storrs Station as an agronomist.

W. H. Twenhofel, of the University of Wisconsin, editor of the *Journal of Sedimentary Petrology*, received the honorary D.Sc. degree from the University of Louvain, Belgium, on October 20, 1947.

Sherman Dickman, recently a research associate in biochemistry at Columbia University, has joined the staff of the Department of Biochemistry, University of Utah School of Medicine, Salt Lake City, as assistant professor.

Gian C. Wick, professor of physics, University of Notre Dame, has been appointed professor of physics, University of California, Berkeley, effective July 1.

Philip T. Kirwan has been appointed technical editor in the Information and Editorial Branch, Technical Services Division, Chemical Corps Technical Command, Army Chemical Center, Maryland. He was previously a senior technical aide in the Office of Scientific Research and Development, Washington, D. C., serving in the Liaison Office and in Division 3, NDRC (Rocket Ordnance).

C. L. W. Swanson, head of the Soils Department at the Connecticut Agricultural Experiment Station, has been named chairman of the Subcommittee on Soil Surveys of the North-

eastern Regional Soil Research Committee. The new subcommittee will advise on all soil surveys performed by the agricultural experiment stations in the 12 states included in the region, as well as planning national surveys with committees of the other three regions. Dr. Swanson has had wide experience in soil survey work and organized the first reconnaissance soil survey of Japan in 1945 (*Science*, September 19, 1947, p. 256).

James S. Murray, who has been director of research at the Warner Company of Philadelphia since 1930, has been appointed associate professor of materials in the Department of Building Engineering and Construction, Massachusetts Institute of Technology. There he will be in charge of the masonry materials research laboratory.

Woodrow M. Morris, director and chief psychologist, Division of Special Clinical Services, Bureau of Psychological Services, Institute of Human Relations, University of Michigan, has been appointed assistant professor of clinical psychology and senior psychologist in the Psychopathic Hospital at the State University of Iowa.

R. J. Pool, chairman of the Department of Botany, University of Nebraska, since 1915 and a member of the faculty for 40 years, has resigned as chairman but will continue on the departmental staff as professor of botany. **W. W. Ray**, formerly of Oklahoma A & M College, succeeds Dr. Pool.

Edward L. Tatum, biochemical geneticist, will rejoin the faculty of Stanford University in September as professor of biology, it was announced recently. Joining the Stanford faculty in 1937 as a research associate, Dr. Tatum later became an assistant professor of biology. In 1945 he accepted an associate professorship at Yale, later becoming a full professor in Yale University's new Institute of Microbiology.

Lloyd Van Doren, chemical consultant specializing in patent matters and registered patent agent, is now located at 30 East 40th Street, New York City.

Wilbur A. Selle, professor of physiology, and director, Laboratory of Medical Physics, University of Texas Medical Branch, has been appointed visiting professor of physiology, University of Arkansas School of Medicine, and will spend several weeks there at the close of the semester. Dr. Selle will return to Galveston to direct a postgraduate course in physical medicine to be held March 1–5 at the Medical Branch.

Sidney S. Negus, professor of chemistry, Medical College of Virginia, Richmond, has been appointed administrator of the Richmond Area University Center, "a piece of modern educational machinery" designed and operated by the officers and faculties of Hampden-Sydney College, Medical College of Virginia, Randolph-Macon College, University of Richmond, University of Virginia, College of William and Mary, Richmond Professional Institute, Union Theological Seminary, and General Assembly's Training School. Dr. Negus will devote part time to administering the affairs of the Center. Information concerning this educational experiment may be obtained from the administrator.

Visitors to U.S.

G. G. Taylor, a plant pathologist from the Plant Diseases Division, Department of Scientific and Industrial Research, New Zealand, has arrived in the United States to take over the headship of the New Zealand Scientific Liaison Office, located in Washington, D. C. Dr. Taylor, who has replaced **J. A. D. Nash** in that capacity, expects to remain here about a year.

Chi-Ping Cheng, instructor in physiology at Hsiang-Ya Medical College, Changsha, China, and Traveling Research Fellow of the American Bureau for Medical Aid in China, is now a Visiting Research Fellow in the Department of Pharmacology, University of Utah School of Medicine, working under L. S. Goodman. **Chuan-Yen Wang**, of the National Institute of Health, Nanking, China, and a Honan Provincial Government Traveling Scholar, is doing graduate work in the same department.

Jack Still, professor of biochemistry, University of Sydney, Australia, recently visited the University of Texas Medical Branch to survey studies on enzyme chemistry being made by Witkor Nowinski, research associate, Tissue Culture Laboratory. Dr. Still, who is a Rockefeller Traveling Fellow, plans to work with David E. Green at Columbia University.

Grants and Awards

The Forsyth Dental Infirmary for Children, Boston, has received a 5-year grant of $25,000 from the Charles H. Hood Dairy Foundation in support of a long-term study of growth and development of the teeth and jaws in relation to the problem of "malocclusion" of the human dentition. Participating in the study from the Forsyth staff are: C. F. A. Moorrees, orthodontist; Stanley M. Garn, physical anthropologist; and V. O. Hurme, director of clinical research. An Advisory Committee for the program consists of: George B. Wislocki, James Stillman professor of comparative anatomy, Harvard Medical School; Harold C. Stuart, professor of maternal and child health, Harvard School of Public Health; Earnest Hooton, professor of anthropology, Harvard University; and Roy O. Greep, associate professor of dental science, Harvard School of Dental Medicine.

Harry T. Kelsh, of the Soil Conservation Service, U. S. Department of Agriculture, was presented the Sherman Mills Fairchild Award at the annual meeting of the American Society of Photogrammetry, held recently in Washington, D. C. The award, made annually to the man making the past year's outstanding contribution to photogrammetry, was given to Mr. Kelsh for his development of the Kelsh Plotter, an instrument which maintains the simplicity of a projection system in the compilation of maps from aerial photographs.

Roger B. Friend, chief entomologist, Connecticut Agricultural Experiment Station, is the 1948 recipient of the Award of Merit of the Connecticut Tree Protective Association. The award, made during the recent annual

one-day meeting of the Association, was given Dr. Friend in recognition of his contributions to forestry and arboriculture in Connecticut, particularly in the field of forest insect control.

The American Society of Plant Physiologists, at its annual meeting in Chicago December 27–30, selected Wightman W. Garner and Henry A. Allard as recipients of the Charles Reid Barnes Life Membership Awards. C. H. Wadleigh, secretary of the Society, in reporting the awards, states that "it is most appropriate that these two outstanding plant physiologists should be paid tribute by the ASPP in that their investigations led to the one contribution to plant physiology which is wholly American in its conception and development—photoperiodism.

The Society also honored four leading plant physiologists in other lands by conferring on them Corresponding Membership Awards. The four professors are Hans Burstrom (Sweden), Runar Collander (Finland), F. G. Gregory (England), and Albert Frey-Wyssling (Switzerland).

Fellowships

The U. S. Atomic Energy Commission last week announced a fellowship program for training qualified persons for careers in the medical and biological aspects of atomic energy. AEC will finance the program (approximately $1,000,000 has been budgeted for the first year) and establish the operating policies and training goals to be met. Selection of candidates and other administrative duties, however, will be carried out by the National Research Council, from which a detailed announcement will be forthcoming in the near future.

Although applicants from any branch of biology and medicine are eligible, at present preference will be given to those intending to follow a career of research in one of the basic biologic or medical sciences as related to the field of atomic energy, or clinical medicine or surgery as related to that field. Those applying in medicine and surgery will be encouraged to lay out a program of study leading to thorough experience in a preclinical science so that they may become identified with this science as such rather than primarily with its application to clinical studies. Initial fellowships are to be distributed among Doctors of Medicine, Doctors of Philosophy in the biological sciences, and Bachelors of Science and of Arts, who will receive training in health physics. Fellowships in the first two categories will extend for two years, while graduate training in health physics will be for one year or longer. Fellows will have a certain amount of latitude in selecting universities or laboratories at which to study, and although they will have an opportunity to do so, they will not be committed to work in AEC installations following their training. Results of work done by Fellows under the program may be published without restriction except in cases where such restriction is required for security reasons.

The expansion of AEC facilities has made it even more clear that the shortage of trained scientific personnel in fields directly related to atomic energy is serious. To increase its own resources and those of the Nation as a whole, AEC has therefore launched this important program.

Tau Beta Pi (engineering honor society) is again offering Fellowships for Graduate Study in Engineering for the school year 1948–49. Four to six such awards will probably be made this year. Each fellowship carries a stipend of $1,100, which may in many cases be enhanced by remission of most or all of the tuition fees of the school of the recipient's choice. February 29 is the final date for mailing of applications to the Director of Fellowships, Paul H. Robbins, 1359 Connecticut Avenue, N.W., Washington 6, D. C.

The Yale University School of Medicine announces that applications are now being accepted for postdoctorate research fellowships for 1948–49. These are the Alexander Brown Coxe Memorial Fellowships in the Biological Sciences, established in 1927 and available for investigation in the field of the biological sciences, including medicine, and the James Hudson Brown Memorial Fellowships, established in 1946 and available for promising applicants qualified to undertake research in the medical sciences, including clinical medicine and public health. The fellowships are open to university graduates who hold the Ph.D. or M.D. degree, preference being given to those who have previously demonstrated fitness to carry on research. They are awarded ordinarily for one year but may be renewed. The annual stipend, although determined by individual circumstances, is usually from $2,500 to $3,500. An additional sum may be assigned to the department of study to defray, in part, the cost of the proposed investigation. The closing date for applications is March 1, 1948. Application forms and additional information may be secured from C. N. H. Long, Dean, Yale University School of Medicine, 333 Cedar Street, New Haven 11, Connecticut.

Colleges and Universities

The University of Krakow Observatory will shortly be the recipient of a 20-inch reflecting telescope, Poland's largest. With the recent donation of $500 by the Polish National Home Association of Rhode Island, solicitation of funds for this purpose has reached the half-way mark, Charles H. Smiley, director of the Ladd Observatory, Brown University, and secretary of the National Books-for-Poland Committee, has announced.

Stefan Piotrowski, of the Krakow Observatory, who is to sail for home shortly, stated that the telescope would be used primarily in the photoelectric measurement of the brightness of eclipse variables. Dr. Piotrowski, a noted authority on eclipsing variable stars, has been conducting research at Harvard College Observatory this year on an Agassiz Fellowship provided by Harvard through the Kosciuszko Foundation.

Pomona College announces the establishment of a high-pressure catalytic laboratory with memorial funds given the college in honor of the late Frederick Arthur Schmidt, a first lieutenant killed in World War II. The laboratory, while planned primarily for research on heterogeneous catalysis under high pressures and temperatures, will also provide undergraduate instruction facilities in this field.

The School of Medicine, Western Reserve University, is organizing a Department of Microbiology, in recognition of the fundamental importance of the chemistry and physiology of the cell. Lester O. Krampitz will head the new department as professor of microbiology. Dr. Krampitz will begin immediately to select a staff for an efficient teaching and research program.

The Division of the Geological Sciences, California Institute of Technology, announces the appointment of R. Dana Russell as visiting professor and of C. Hewitt Dix as associate professor. Dr. Russell, consulting geophysicist for the U. S. Navy Electronics Laboratory, will work in sedimentary petrology, a field to which he has made many contributions. Dr. Dix, geophysicist with the United Geophysical Company for the past 6 years, will specialize in the seismic and gravitational phases of applied geophysics.

The Polytechnic Institute of Brooklyn is to offer the new degree of Master of Science in Applied Mathematics to meet the growing need for mathematical knowledge applicable to all engineering fields. This degree, offered by only a few technological schools in the country, meets the demand for broader applications of basic sciences stimulated by wartime developments. R. M. Foster, head of the Department of Mathematics, former research mathematician in the Bell Telephone Laboratories and authority on network theory and Fourier transforms, has directed development of the curriculum and staff for the program.

Summer Programs

A course on the Biochemistry of Cancer will be offered by Jesse P. Greenstein, chief, Biochemistry Section, National Cancer Institute, under the auspices of the Division of Biochemistry, University of California, Berkeley, June 21–July 31. The course, the first of its kind ever offered in a U. S. university, constitutes a part of the program of research into the origin, prevention, and cure of cancer which has been inaugurated by the University with the aid of an appropriation from the State Legislature.

The Mt. Desert Island Biological Laboratory, which will celebrate its 50th anniversary this summer, is again offering its facilities for research and study in biology from June 15 to September 15. The laboratory buildings, which were not damaged by the recent fire, are in an unusual location, with sea, fresh-water lakes and streams, and mountain and forest areas in the immediate vicinity. Laboratory rooms, which rent from $75 to $200 for the season, will accommodate from one to several people. The buildings are equipped with running salt and fresh water, electricity, Pyrofax gas, basic glassware, and chemicals. Also available is a darkroom building, a large, modern dock equipped with wells and live cars, and a motor dory and skiffs for nearby marine collecting. In addition, there is a newly-equipped laboratory for studying problems in tissue growth, which is under the supervision of Philip R. White. Those desiring to work with Dr. White, should first contact him at the Institute for Cancer Research, Girard and Corinthian Avenues, Philadelphia 30, Pennsylvania. Applications for rooms should be sent to J. Wendell Burger, Director, Trinity College, Hartford 6, Connecticut. The assignment of rooms and facilities will be made May 1, following the order of receipt and special needs.

The Department of Physics, University of California, Berkeley, has announced that visiting professors for the first summer session of 1948 (June 21–July 31) will be J. R. Oppenheimer, Institute for Advanced Study, Princeton, New Jersey, and W. W. Watson, Yale University, and for the second session (August 2–September 11), D. M. Dennison, University of Michigan, Enrico Fermi, University of Chicago, and N. F. Ramsey, Harvard University. Each professor will offer an advanced course in physics and a seminar.

Meetings

The Eastern Association of Electroencephalographers announces its Montreal meeting, to be held February 27–29 at the Montreal Neurological Institute; social and sports activities are also included in the program. Inquiries regarding the meeting may be addressed to John Abbott, EAEEG chairman, 125 Steele Road, West Hartford 7, Connecticut.

The American Society of Mechanical Engineers is holding its spring meeting March 1–4 in New Orleans. Several hundred members of the Society are planning to attend the four-day program of technical and general sessions. In the 8 technical sessions, industrial speakers will present papers on gas turbines, metals engineering, power, materials handling, heat transfer, fuels and processing, and management. Theme of the opening luncheon program, to be held at the St. Charles, headquarters hotel, will be nuclear energy. Inspection trips will include tours of local industrial plants. Full details of the meeting may be obtained from Ernest Hartford, Executive Assistant Secretary, ASME, 29 West 39th Street, New York 18, New York.

The American Association of Anatomists, by invitation of the University of Wisconsin, will hold its 61st meeting in Madison April 21–23. Demonstrations and all other sessions will be held at the Memorial Union building of the University. Chairman of the local committee is T. H. Bast, Department of Anatomy, University of Wisconsin; H. W. Mossman, of the same department, is in charge of demonstrations and motion pictures; and F. D. Geist, also of the Anatomy Department, is in charge of hospitality. The Association's secretary, Normand L. Hoerr, of Western Reserve University, has issued a call for titles and abstracts of papers, demonstrations, and motion pictures, as well as demonstration specification cards to be submitted not later than February 16.

The American Section, International Scientific Radio Union, and the **Institute of Radio Engineers** will hold their annual joint meeting in Washington, D. C., May 3–5, 1948. The program will, as usual, be devoted to the more fundamental and scientific aspects of radio and electronics. The program of titles and abstracts will be available in booklet form for distribution before the meeting. Anyone wishing to submit papers for presentation at this meeting

should send in title and a 100-word abstract as soon as possible to Dr. Newbern Smith, Secretary, American Section, URSI, National Bureau of Standards, Washington 25, D. C. Correspondence should be addressed to the Institute Office, 1 East 79th Street, New York 20, or to Dr. Smith.

The Western Society of Naturalists held its annual winter meeting, December 29–31, at the University of California, Berkeley.

On Monday afternoon a symposium on "Variation of Species in Relation to Climate" was held jointly with the California Botanical Society. H. E. McMinn, of Mills College, president of that organization, organized the session, in which the following participated: Lyman Benson, Pomona College; F. A. Pitelka, University of California, Berkeley; Jens Clausen, Carnegie Institution of Washington; and G. L. Stebbins, University of California, Berkeley. Monday evening the Society enjoyed a film on bird life by Mrs. Laura Reynolds.

On Tuesday morning the Society held a symposium on "Chemical Control of Plant Growth" which was directed by J. Van Overbeek, Shell Agricultural Laboratory, Modesto, California. Others who participated on this program were Rene Blondeau, Shell Agricultural Laboratory, Modesto, California; Jacob Biale, University of California, Los Angeles; and William S. Stewart, University of California, Riverside.

At the annual dinner the retiring president, George W. Beadle, of California Institute of Technology, gave an address on "Recent Advances in Genetics."

Wednesday morning a symposium on "Problems of Desert Animals," organized by Raymond B. Cowles, was held. Others participating were Charles T. Vorhies, University of Arizona; Wade Fox, Jr., University of California, Berkeley; A. M. Woodbury, University of Utah; and Ross Hardy, Weber College, Utah.

Fourteen miscellaneous papers on diverse aspects of biology were presented at the Tuesday and Wednesday afternoon sessions.

Officers elected for the coming year are: president, Denis L. Fox, Scripps Institution of Oceanography; vice-president, Raymond Selle, Occidental College; secretary-treasurer, H. W. Graham, Mills College; members of Executive Committee, A. R. Moore, University of Oregon, and Garret Hardin, Santa Barbara College of the University of California. (HERBERT W. GRAHAM, *Secretary.*)

Elections

The Society of American Foresters has recently elected Clyde S. Martin, chief forester, Weyerhaeuser Timber Company, Tacoma, Washington, as president to succeed Shirley W. Allen, professor of forestry, University of Michigan, and Charles F. Evans, assistant regional forester for the southern region, U. S. Forest Service, Atlanta, Georgia, as vice-president. The president, vice-president, and 9 additional members compose the governing Council, to which the following were elected: Willis M. Baker, Tennessee Valley Authority; Paul M. Dunn, Oregon State College; James C. Evenden, U. S. Department of Agriculture, Coeur d'Alene, Idaho; Charles H. Flory, South Carolina Commission of Forestry; William B. Greeley, West Coast Lumbermen's Association, Seattle; Clarence S. Herr, Brown Company, Berlin, New Hampshire; Richard E. McArdle, U. S. Forest Service, Washington, D. C.; DeWitt Nelson, Department of Natural Resources, Sacramento, California; and John W. Spencer, U. S. Forest Service, Denver, Colorado.

Election to the grade of Fellow is the highest honor the Society can confer on a member. In addition to the foregoing officers, the following were elected as Fellows: Shirley W. Allen, University of Michigan; Hugh P. Baker, University of Massachusetts; Tom Gill, Charles Lathrop Pack Forestry Foundation; Dwight S. Jeffers, University of Idaho; Walter C. Lowdermilk, Berkeley, California; Raymond E. Marsh, U. S. Department of Agriculture; Clyde S. Martin; David T. Mason, of Mason, Bruce, and Girard, Portland, Oregon; John F. Preston, Dickerson, Maryland; Stuart B. Show, United Nations Food and Agriculture Organization; and George H. Wirt, Pennsylvania Department of Forests and Waters.

The Torrey Botanical Club (incorporated in 1872), at its annual dinner meeting at Hunter College, New York City, on January 8, elected the following officers for 1948: John A. Small, New Jersey College for Women, president; George S. Avery, Brooklyn Botanic Garden, 1st vice-president; Wendell H. Camp, New York Botanical Garden, 2nd vice-president; Jennie L. S. Simpson, Hunter College, corresponding secretary; Donald P. Rogers, New York Botanical Garden, recording secretary; Elva Lawton, Hunter College, treasurer; Harold W. Rickett, New York Botanical Garden, editor; Harold H. Clum, Hunter College, business manager; and Lazella Schwarten, Gray Herbarium, bibliographer.

The Mineralogical Society of America has announced election of new officers for 1948. These are: Martin A. Peacock, University of Toronto, president; Adolph Pabst, University of California, Berkeley, vice-president; C. S. Hurlbut, Jr., Harvard University, secretary; Earl Ingerson, U. S. Geological Survey, Washington, D. C., treasurer; Walter F. Hunt, University of Michigan, editor; and Clifford Frondel, Harvard University, councilor (1948–51).

The American Society of Naturalists, at its meeting in Chicago on December 31, elected Paul R. Burkholder, Department of Botany, Yale University, president for 1948; T. M. Sonneborn, Department of Zoology, Indiana University, vice-president for 1948; and Donald P. Costello, Department of Zoology, University of North Carolina, treasurer for 1948–50. W. S. Stone, Department of Zoology, University of Texas, is secretary of the Society.

Deaths

George B. Wallace, 72, professor emeritus at the New York University College of Medicine and founder of the Department of Pharmacology of the college, died in New York City January 15.

Hermann Rudolph Bernhard, 62, professor of chemistry at Marietta College, died suddenly on January 17 at his residence in Williamstown, West Virginia.

William Lindsay Malcolm, 63, director of the School of Civil Engineering at Cornell University since 1938, died January 18 following a heart attack.

Fred Conrad Koch, 71, Frank P. Nixon distinguished service professor emeritus of biochemistry, University of Chicago, and director of biochemical research at Armour and Company, died suddenly January 26. Dr. Koch became associated with the University in 1909.

John G. Jenkins, 46, head of the Department of Psychology, University of Maryland, died January 30 in College Park. During the war Dr. Jenkins was chief of the Aviation Psychology Branch, Bureau of Medicine and Surgery, Navy Department.

The Atomic Energy Commission has announced that the first shipment of stable isotopes from Oak Ridge was consigned on January 21 to M. L. Pool, of Ohio State University's Physics Department. Dr. Pool received stable isotopes of molybdenum 92, 94, and 98, germanium 70 and 76, and selenium 74 and 76, which will be bombarded in the University's cyclotron for studies of nuclear reactions and transmutations. On January 22 other shipments including lithium 6 and 7, boron 11, magnesium 25, silicon 29, chromium 50, iron 54, zinc 67, and lead 204 were made to Samuel K. Allison, director, Institute for Nuclear Studies, University of Chicago; T. Lauritsen, California Institute of Technology; M. L. Perlman, General Electric Company, Schenectady, New York; and J. E. Mack, Department of Physics, University of Wisconsin.

Availability of over 100 stable isotopes of 29 elements was announced by AEC in December. Since the supply of these isotopes is limited and production costs high, they are being furnished to laboratories throughout the country only on a loan basis. Request for an allocation must be made by the interested laboratory to the Isotopes Division, AEC, Oak Ridge, Tennessee. Upon approval of the request, the requestor must forward a purchase order of $50 for each enriched sample to the Carbide and Carbon Chemicals Corporation, Isotopes Office, Oak Ridge, which produces the isotopes in an electromagnetic separation plant and which will ship the material prepaid by railway express. Upon completion of the research, or within the date specified on the allocation, the material must be returned, express prepaid by the laboratory.

AEC recently announced appointment of a new Advisory Committee on Isotope Distribution. On January 1 this Committee replaced the Interim Committee which has been advising the Commission on matters of distribution policy, allocation, and human applications. G. Failla, Columbia University Medical School, is chairman of the newly appointed group which also consists of H. L. Friedell, Western Reserve University; A. H. Holland, Jr., medical adviser at Oak Ridge; J. G. Hamilton, University of California; J. W. Kennedy, Washington University, St. Louis; R. D. Evans, Massachusetts Institute of Technology; Austin M. Brues, Argonne National Laboratory; L. N. Nims, Brookhaven National Laboratory; H. A. Barker, University of California; Henry Borsook, California Institute of Technology; and P. C. Aebersold, chief of the Isotopes Branch at Oak Ridge. Dr. Aebersold is serving as secretary of the Committee and of its Subcommittees on Human Applications and on Allocation and as liaison representative of AEC.

Current medical and scientific data on poliomyelitis are depicted graphically in a set of scientific exhibits prepared by the National Foundation for Infantile Paralysis as part of its professional education program and now available for annual meetings of state and regional medical associations. These exhibits cover diagnostic criteria, techniques of muscle testing, histopathology, syndromes of bulbar poliomyelitis, results of scientific research on virus characteristics, role of flies and sewage, and a working hypothesis of transmission during epidemics. Further information concerning the exhibits may be obtained from the Director of Scientific Information, National Foundation for Infantile Paralysis, 120 Broadway, New York 5, New York.

The Office of Technical Services, Department of Commerce, announces the availability of a classified printed list of 1,800 reports on German, Japanese, and American wartime technology. Of the reports included in the 57-page classified list, 84 are concerned with aeronautics, 309 with chemicals, 73 with electrical equipment, 47 with food products, 108 with fuels and lubricants, 79 with machinery other than electrical, and 85 with textiles. Some of the most valuable information found by American investigators in two years of searching German firms and laboratories is included in these reports. Multilith copies of the listing, PB–81500 (*Classified list of OTS printed reports*; 57 pp.) sell for $.75. Orders for the listing, stating PB number and accompanied by a check or money order made payable to the Treasurer of the United States, should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Abstracts of the reports contained in the listing PB–81500 may be found in the *Bibliography of Scientific and Industrial Reports.* The Bibliography is a weekly publication prepared by OTS containing abstracts of scientific and technical reports. Subscriptions at $10 per year may be placed with the Superintendent of Documents, Washington, D. C.

Make Plans for—

American Society of Experimental Pathology, March 15–20, Atlantic City, New Jersey.

Ohio Society of Professional Engineers, March 18–20, Netherland Plaza Hotel, Cincinnati, Ohio.

Chicago Technical Conference, in conjunction with annual Chicago Production Show, March 22–24, Stevens Hotel, Chicago, Illinois.

Symposium on "Modern Instrumental Methods of Analysis," sponsored by Minnesota Section, American Chemical Society, and Institute of Technology, March 22–24, University of Minnesota, Minneapolis.

Institute of Radio Engineers, March 22–25, 1 East 79th Street, New York City.

Comments and Communications

A Living *Metasequoia* in China

It is a rare occurrence when a plant genus originally based on paleobotanic records is found to have a living representative. In 1941 the genus *Metasequoia* was proposed and described to take certain species which had originally been described by various paleobotanists as representatives of the genus *Sequoia*; and, strange as it may seem, only 5 years after the group was characterized, a Chinese forester, Mr. Wang-chan, actually discovered three living trees representing an undescribed species of the genus in Szechuan. This discovery was made in February 1946. Later in the year C. Y. Hsueh was sent to Wan-hsien by Prof. Wan-Chun Cheng, of the National Central University of Nanking, to secure additional material. His field work brought the census of the large trees up to about 25 in the vicinity of Wan-hsien.

Intrigued with the possibility of securing seeds of this remarkable species when botanical specimens were received at the Arnold Arboretum early in 1947, a modest grant was made to Dr. H. H. Hu, of the Fan Memorial Institute of Biology, Peiping, in the summer of 1947. With this fund it was possible for Prof. Cheng to send a third expedition to the type locality in the fall of 1947, the leader of this expedition also being Mr. Hsueh. He spent about three months in the field, brought the census of the large trees up to over 100, and—what is most interesting—secured a quantity of seeds. He returned to Nanking early in December, and the first shipment of seeds of this new living species of *Metasequoia* reached the Arnold Arboretum on January 5, 1948.

Mr. Hsueh's field work in 1947 brought out the fact that the species actually extends into adjacent parts of Hupeh Province. This is a region not exactly unknown to European botanists, for at least two very keen collectors had traversed the region, one in the last century, the other in the early part of the present one. The large trees occur as widely scattered individuals over a distance of at least 100 miles, the Shui-sa-pa Valley in Hupeh taking its name from the local name of the species, *shui-pa* (*shui* = pine). We have no information, as yet, as to what the reproduction of the species may be, but the large old trees are very widely scattered. It is clear, however, that this sole living representative of a very ancient genus is now apparently on the verge of extinction. Seeds have already been distributed to selected institutions in various parts of the United States and Great Britain, and it is hoped that, somewhere, we may be able to establish the species in cultivation. A larger supply of seeds is expected in the near future.

Metasequoia, or its immediate ancestors, developed in Mesozoic times, when the animal life of the globe was dominated by the long-extinct giant reptiles. Like *Sequoia*, it was formerly of very wide distribution in the North Temperate Zone. To it has been transferred several paleobotanic species originally placed in *Sequoia*, from North America, Japan, Saghalien, and Manchuria. But the one living species now persists in a limited area in China, even as the two species of *Sequoia* persist in limited areas in California, last stands of ancient and formerly widely distributed types. It is suspected that the chances of this species persisting much longer in this, its last stand, are not too promising.

The discovery of a living representative of *Metasequoia* is an event of extraordinary interest to both botanists and paleobotanists. Two other cases occur to me where genera, actually described from living species of eastern Asia, prove to have been described under earlier and different names by the paleobotanists. Thus, *Petrophiloides*, originally described from fossil fruits found in the London clay flora, is older than *Platycarya*, the sole living species being of wide distribution in eastern Asia. *Caryojuglans*, originally described from fossil forms found in Europe, long antedates *Rhamphocarya*, the latter having been described in 1941 on the basis of living specimens found in Yunnan. These are both genera of the Juglandaceae, not as old, geologically speaking, as is this remarkable coniferous *Metasequoia*.

This living *Metasequoia* is a large tree, attaining a height of about 35m, with a trunk diameter up to 2.3m. A remarkable character about it is that, like *Larix* and *Pseudolarix*, it is deciduous, the trees being leafless in the winter months. Its botanical alliance is scarcely with *Sequoia*, as one might infer from the generic name. In its vegetative characters it suggests *Glyptostrobus* and *Taxodium*, but it may prove to be not closely allied to these two genera, one of southeastern China, the other of North America. Its technical description is not yet published, but when this appears, the true alliance of this ancient type will doubtless be determined.

E. D. Merrill

Arnold Arboretum

AAAS Meetings and Lantern Slides

During the recent AAAS meetings in Chicago, I heard 52 papers presented at the several sections of the Botanical Society of America and related organizations. The authors of 23 of these (nearly half the total) interspersed their talks with apologies for their lantern slides. The slides, which justly deserved profound apologies, had a common objectionable feature, namely, the crowded inclusion of such excessive amounts of data that persons seated more than three rows from the screen were unable to read either the numbers or the accompanying legends. The acme of wasted visual-aids effort was attained by one standard-sized lantern slide which presented 16 vertical columns and 12 horizontal columns of numerical data, so crowded that the perpetrator of the slide, although he stood within 8 feet of the screen, could scarcely decipher his own figures. Obviously, slides of this type contribute nothing to the understanding of the audience and are better omitted. In preparing such slides, the authors utilize the method of photographic reduction of tables prepared by typewriter, gummed-

paper numbers, or hand lettering with the aid of lettering devices, and commonly reduce their tables so extremely that illegibility is the result.

I plead, not only for myself but for other disgusted persons as well, for a new deal in lantern-slide making, for a general reduction in the quantities of data presented on a single slide, and for more care in the arrangement of figures on such slides. The persons who attend such sessions, lengthy as they are and consisting of many papers presented in rapid succession, are interested primarily in the experimental procedures used and in the general conclusions derived from the experiments, not in masses of detailed data. George Sarton, in *The scientific basis of the history of science* (Carnegie Instn Publ. No. 501, 1938, 456–481) has commented succinctly and pointedly upon this aspect of paper presentation: "Oral teaching is essentially different (from written teaching), for an audience, however carefully it may listen, cannot analyze the details, but only obtain a general impression of a subject. . . . In fact it would be wrong for him (the oral teacher) to overload his account with details which would simply obscure his message without compensation. . . . The best proof that that distinction is generally overlooked is the common practice of 'reading' papers at scientific meetings. It is clear that a paper carefully written for the sake of students who will examine it, each by himself at his own speed, cannot be meant to be read aloud to a group of other men, however attentive the latter may be. To read aloud in public a paper meant to be scrutinized quietly in one's own workshop is just as foolish as it would be to paint dainty miniatures on the surface of large walls. The walls call for broad frescoes; and so do listening audiences wait for general outlines, which they can understand and assimilate at once, not for microscopic analyses which they are unable to follow."

Mr. Sarton's comments may be somewhat extreme, for many scientists, hearing scientific papers, desire to see the basic data from which the general conclusions are derived. Nevertheless, more discrimination can be used in the selection of data for visual presentation and more care exercised in their physical preparation. I therefore make the following specific recommendations:

(1) In preparing lantern slides of numerical data, use a direct typing method rather than a photographic reduction method. Commercial lantern-slide blanks, consisting of cellulose-compound films and a special type of carbon paper which does not smear, are available for direct typing. Or one may prepare his own slides, utilizing the Permafilm method described by Hans Neuberger (*Science*, January 2, p. 23). Slides thus prepared produce projected images clearly readable by all persons in an auditorium seating up to 500 persons.

(2) Use standard $3\frac{1}{4}'' \times 4''$ slides in preference to $2'' \times 2''$ slides for tabular presentations of data.

(3) If photographic reduction is essential to the inclusion of larger quantities of pertinent data, the reduction should be slight. In no case should more than 6 vertical and 5 horizontal columns be used on one slide.

(4) Data bearing upon the several aspects of a single problem or experiment should be presented on successive slides, rather than upon the same slide. For example, if one has performed investigations upon four experimental groups of a plant species and has examined their reactions to differing conditions in terms of, let us say, their total nitrogen, nitrate nitrogen, amino nitrogen, total carbohydrates, reducing sugars, polysaccharides, auxin content, magnesium, calcium, phosphate, etc., it is impossible to group all these data on one slide without such extreme reduction that the slide cannot be read. It is better to group the data on nitrogen fractions on one slide, those on carbohydrates on another, those on mineral constituents on another, etc.

(5) Whenever possible, data should be presented graphically. In preparing such slides, one should avoid using more than four or five curves per slide. The use of graphs makes possible the presentation of more data for comparative purposes on one slide than does the use of columns of numbers and is better adapted to the type of experimental report mentioned in the preceding paragraph.

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Projection of Artificial Meteor Trails on the Moon

N. J. Giddings, of Riverside, California, some years ago observed flashes of light apparently crossing the dark side of the young moon, which flashes were entirely confined to the moon and were not seen in the sky on either side. Dr. Giddings (*Science*, August 9, 1946, p. 146) requested an explanation.

I contributed a rather obvious suggestion (*Science*, November 8, 1946, p. 448), namely, that Giddings had seen a flight of meteors projected against the relatively dark, earth-lit side of the moon, invisible in the free sky because of magnitude equal to sky light but seen against the moon because of contrast with the "dark" background of the earth-lit portion. It was objected that this was impossible because the sky projected on the moon is actually brighter than the sky outside by the amount of total moonlight contributed. The point was well taken but was irrelevant, since in such a case the eye would compare, not the brightness of meteor and sky (assumed to be equal) but meteor and *background* seen *through* the sky—in this case assumed to be the dark side of the moon.

In June 1947, when conditions approximated those at Giddings' original observation, I tested this hypothesis by means of an apparatus consisting of a tube, 2″ in diameter, blackened inside, having a short length of resistance wire mounted within the tube between two diaphragms having apertures of 2 cm, the whole unit being 31″ from the eye end of the tube. The resistance wire was connected through outside leads to a rheostat by means of which its state of incandescence could be regulated at will. The first test was run June 22, 1947, at 6:00 P.M. (E.S.T.), the moon then being 4 days after new in a cloudless sky.

The wire was adjusted to white heat and the tube turned to the sky, the wire being visible as a thin, bright line projected on the sky to several degrees west of the moon. Its temperature was then reduced until it made a *black* line against the sky. When turned upon the moon, this line appeared as a feeble *red* line against the dark side of the moon, though remaining black in the sky outside. The test (which was witnessed) was repeated in the July lunation with the same result.

It is felt, therefore, that Dr. Giddings' original observation is entitled to serious credit, and that probably he had the absolutely unique experience of catching a flight of meteors at the moment of projection against the moon.

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Value of Cytochrome C in Anoxia of Newborn Guinea Pigs

Recent reports by Proger and his associates (*J. clin. Invest.*, 1945, 24, 864; *Science*, October 25, 1946, p. 389; *J. Pediat.*, 1946, 29, 729) concerning the role of cytochrome C as a therapeutic agent in combating the effects of tissue anoxia in man have aroused considerable interest. Proger has stated that cytochrome C is present in suboptimal amounts for the most efficient utilization of oxygen in the tissues and that injection of this material results in an increase in the blood and organ content of cytochrome. He has further shown that addition of cytochrome to homogenized tissue suspensions is followed by an increase in oxygen uptake. On the basis of these studies Proger has suggested that cytochrome might be useful in the treatment of asphyxia of the newborn.

As a preliminary to the possible application of this agent in human subjects we have studied the value of cytochrome C in counteracting the effects of induced anoxia in newborn guinea pigs. Animals less than 24 hrs old were placed in a chamber containing an atmosphere of pure nitrogen and allowed to remain until they had gone through a cycle of hyperpnea, convulsions, and, finally, slow gasping respirations or cessation of respirations. They were then removed from the chamber to permit recovery under normal atmospheric conditions. This process was repeated from 2 to 5 times, usually until prolonged artificial respiration was necessary for resuscitation. Prior to the test, each litter was divided, half the animals receiving an intraperitoneal injection of 1.9 mg of cytochrome C and the other half serving as controls. The tests were carried out 1 hr after injection.

We attempted to determine, first, whether injected animals, by virtue of more efficient utilization of oxygen remaining in their tissues, might retain consciousness for a longer period than uninjected litter mates sharing the chamber with them; second, whether injected animals, after cessation of respirations, could be more rapidly revived by artificial respiration and whether they would show a lesser immediate mortality; third, whether injected animals could be protected from the damaging sequelae of cerebral anoxia. In this connection, surviving animals at 12–16 weeks of age were tested for their ability to solve an alternating maze problem similar to that described by Windle and Becker (*Amer. J. Obstet. Gynec.*, 1943, 45, 183). The final score based on 35 trial runs took into account the factors of time, error, and necessity for prodding stimulation. Thus, the higher the score, the poorer the performance.

The results are summarized in Table 1. There was no observable difference in the two groups with regard to maintenance of consciousness, ease of resuscitation, or immediate mortality from anoxic exposure. Furthermore, both groups showed essentially similar degrees of impaired performance in the maze when compared with normal animals of the same age.

Recently Potter (*Science*, October 10, 1947, p. 342) has challenged Proger's basic premises with respect to cytochrome and has pointed out that increasing interest in the clinical use of cytochrome indicates the need for further studies. Negative reports by Scheinberg and Michel (*Science*, April 4, 1947, p. 365) and Stadie and Marsh (*J. clin. Invest.*, 1947, 26, 899) have appeared. Our experiments similarly fail to support the idea that cytochrome may be useful in the clinical treatment of anoxic states of newborn infants. It may be mentioned that in a separate series of experiments we attempted to determine the therapeutic efficacy of cytochrome C in the treatment of cyanide poisoning in rats. The results suggested that cytochrome may be of some value in the treatment of this condition. These studies will be described more fully at a later date.

TABLE 1

	No. of animals	Succumbed in chamber	Survived	Died of intercurrent inf.	Maze tests			
					No. of animals	Mean of avg. scores	σ	P.E.
Anoxia + cytochrome	43	11	32	9	17	33.2	3.15	0.52
Anoxia; no cytochrome	42	11	31	11	17	30.9	3.16	0.52
Normal controls	32	..	..	..	32	18.7	1.57	0.19

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TECHNICAL PAPERS

Streptomycin-sensitive, -dependent, and -resistant Bacteria [1]

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The occurrence of a few apparently "resistant" variants in a large inoculum of streptomycin-"sensitive" organisms has been noted in strains of *Shigella* (*3*), *Hemophilus influenzae* (*1*), and meningococcus (*5*). Similar resistant variants of many organisms have usually been obtained from smaller inocula by repeated subculture in increasing concentrations of the antibiotic (*2, 4, 6, 7*). Miller (*5*) described another type of variant of the meningococcus, which apparently requires streptomycin for growth and which was obtained after one exposure to a large concentration of streptomycin.

In this laboratory, two types of variants have been derived from the same "sensitive" strains of the following organisms: *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa,* and *Proteus morgani.* One of the variants, hereafter referred to as "resistant," could grow either in high concentrations of streptomycin or in its absence; the other, which will be referred to as "dependent," grew only in the presence of streptomycin. These variants were obtained by exposure of large numbers of organisms to high concentrations of streptomycin. They usually appeared following the initial exposure of the "sensitive" culture to the antibiotic and represented only a very small proportion of the total number of organisms which had been exposed to the drug.

When these 4 "sensitive" organisms and their derived variants were subcultured in broth containing graded concentrations of streptomycin, using an inoculum of approximately 50,000 organisms/ml, it was noted that growth ceased in the case of both the sensitive and the dependent strains of the same organism at about the same concentration of streptomycin. In other words, the critical concentrations of streptomycin—above which the sensitive strain did not grow and below which the dependent variant failed to grow—were approximately equal for these two strains of the same organism. This is shown in Table 1.

In the course of isolating the dependent variants it was noted that single colonies which had appeared following the first few exposures to streptomycin contained both dependent and sensitive organisms. By repeated subculture of the apparently dependent strains and sensitive strains in both streptomycin-free and streptomycin-containing media, it was possible to obtain pure strains that were either inhibited by streptomycin or dependent on it for growth. The resistant variants, on the other hand, have continued to breed true from the time of their initial isolation.

These observations are in accord with the widely accepted concept of the action of antibacterial agents as metabolite antagonists. Thus, in the case of the sensitive strain, streptomycin may be considered as interfering with some essential metabolite or metabolic process. The dependent strain, on the other hand, utilizes streptomycin as an essential metabolite or growth factor. Furthermore, the same concentrations of streptomycin which interfere with the growth of the sensitive strain are essential for the growth of the dependent strain.

TABLE 1

GROWTH OF SENSITIVE AND DERIVED VARIANTS IN BROTH CONTAINING GRADED CONCENTRATIONS OF STREPTOMYCIN

Organism	Variant	Streptomycin (μg/ml)											
		50,000	10,000	1,000	500	200	100	50	25	12.5	6.2	3.1	1.5	0
Staph. aureus	Sensitive	0	0	0	0	0	0	0	0	++	+++	+++	+++	+++
	Dependent	+++	+++	+++	+++	+++	+++	++	0	0	0	0	0	0
	Resistant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
E. coli	Sensitive	0	0	0	0	0	0	0	0	0	0	+++	+++	+++
	Dependent	+++	+++	+++	+++	+++	+++	+++	++	+	±	0	0	0
	Resistant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
Ps. aeruginosa	Sensitive	0	0	0	0	0	0	0	±	++	+++	+++	+++	+++
	Dependent	+++	+++	+++	+++	+++	+++	+++	++	+	±	0	0	0
	Resistant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
P. morgani	Sensitive	0	0	0	0	0	0	++	+++	+++	+++	+++	+++	+++
	Dependent	+++	+++	+++	+++	+++	+++	+++	±	0	0	0	0	0
	Resistant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++

[1] Aided by a grant from the U. S. Public Health Service.

[2] Research Fellow, American College of Physicians.

Growth of the resistant strain, on the other hand, may take place either in the presence or absence of streptomycin. The latter property appears to be a relatively permanent alteration, while in the case of the dependent strain the relationship between streptomycin and the essential metabolite may be a reversible one.

Details of these and related studies will be presented at a later date.

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The Static Electrification of Dust Clouds

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In studying the passage of finely powdered minerals through a metal tube, we have discovered that the dust coating acquired by the inside of the tube has an important role in the electrostatic charging of the dust clouds formed in that process.

The observations leading to this discovery were made using an apparatus and method similar to that of Wilson, Janes, and Campau (*10*). Attaclay, pyrophyllite, bauxite, and mixtures of these were studied.

Charging tests. The tube was made of brass tubing of ½″ internal diameter, 20″ long, fitted with a jet and venturi orifice at the hopper inlet to increase the suction on the hopper. The tube was insulated by Lucite at its supports and connected to the gas line by a polystyrene adaptor. The blowing gas was dry nitrogen, passed into the tube through a rotameter. The exit end of the tube extended 3″ into a large box used to collect the dust clouds and was paraffined on the outside to prevent discharging of the tube by attraction of the dust clouds onto the metal. A Kelvin voltmeter was used to determine the sign and magnitude of the charge placed on the tube.

A small copper cone was set in the top opening of the hopper. Its bottom opening was easily constricted or widened to regulate the passage of the powder into the tube. Because of the differences in flowability of the powders studied, it was found advantageous to fill the cone rather than the hopper. Furthermore, by separate passage of small units of powder a more detailed picture of the coating and charging was obtained.

The materials used in this study were characterized by the following properties:

	Attaclay	*Pyrophyllite*	*Activated bauxite*
Mineralogical content	Attapulgite: magnesium aluminum silicate	Pyrophyllite: aluminum silicate	γ-Alumina containing kaolinite and anatase
Volatile matter (%)	7.9	3.7	7.5
Packed bulk density, lbs/cu ft	29.7	52.4	60.6
Specific gravity	2.35	2.80	3.19
Screen analysis:			
on 200 mesh	3	0	4
200–325 mesh	11	5	12
through 325 mesh	86	95	84

Before each powder or powder mixture was studied, the tube was cleaned thoroughly. The cone opening was adjusted to suit the powder studied; the cone was filled and put in place in the hopper; and the tube was grounded to remove any precharging, especially that due to contact of the powder with its glass container (*4*, *9*). The cone opening adjustment varied considerably with the powders, since Attaclay flows more readily than pyrophyllite or bauxite. A gas flow of between 1.4 and 1.7 cu ft/min was used throughout. Each coneful was passed through the blower in approximately the same time, 4.5–6 min, and each powder met about the same frictional force in its passage. The tube was discharged after each passage to permit filling the cone with the next sample.

Adhesion tests. These were made with the aid of the blowing system just described. A 3″ square of clean, 0.008″ electrolytic sheet copper was hung vertically by a wire attached to a grounded metal support. It was backed by a piece of cardboard, which prevented motion of the plate and protected its back from deposition of dust. The blower tube was pointed at the center of this plate, the end of the tube being held at a distance of 3 or 6″ from the plate. The dust was blown at the same rate as in the charging experiments and, following the passage of a coneful, the plate was removed, tapped to shake off the looser material, and weighed to determine that which adhered firmly. The tapping procedure was easily made sufficiently uniform because of the sharp demarcation between the adhesion of the loose and the firmly-held material, as attested by the reproducibility of the results. The plate was cleaned carefully between determinations.

Early in the studies, the importance of the coating inside the tube was noticed. Until this had formed, the charge placed on the tube was low and not reproducible, but when the lining had formed, a higher, more constant value was shown. The ease of formation of the lining varied noticeably with the nature of the powder. With Attaclay, this coating was apparently fully formed before the second coneful had passed. With pyrophyllite, 3 conefuls sufficed in general, and with bauxite as many as

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6 were required to complete the lining. In the passage of the pyrophyllite, and more often in that of the bauxite, occasional momentary decays of the voltage gave indication of temporary loss of a portion of the coating.

The linings of Attaclay and of pyrophyllite were uniform, compact, and smooth in appearance, while those of bauxite were striated and rough as a rule. The Attaclay and pyrophyllite clouds were always negatively charged; the bauxite, positive in sign.

The ease of formation of the coating follows the same order as the ease of flow of the powders, as judged roughly by the size of the cone opening required for equal rate of flow, and certainly follows the order of adhesivity of the powders for a metal surface (Table 1).

TABLE 1

THE ADHESION OF THE DUSTS TO COPPER

Powder	Distance (″)	Weight adherent (mg)
Attaclay	6	31.9 ± 2.9
	3	44.1 ± 2.5
Pyrophyllite	6	23.1 ± 0.8
	3	24.8 ± 1.9
Bauxite	6	1.3 ± 0.1
	3	1.3 ± 0.2

Similar but less complete results were obtained with a plate of aluminum foil. Only the Attaclay is appreciably sensitive to the force with which the dust hits the plate, the amount adhering for the 3″ distance being 38% greater than that with the blower 6″ from the plate.

Most striking were the studies of mixed powders. It has long been known that the charging of mixtures behaves in an apparently unpredictable manner, and careful work has shown that small amounts of a foreign substance have a profound effect on the charging of many dusts (*6*, *10*). Here, mixtures of Attaclay with bauxite and of pyrophyllite with bauxite were studied.

On mixing equal volumes of Attaclay and bauxite, the Attaclay alone coated the tube on the passage of the first coneful, and the tube showed a positive charge, indicating that the dust clouds bore the negative charge typifying clay clouds. On passage of the second coneful, the voltage rose from zero, fell back to zero, and finally rose again, the tube showing a negative charge at the end of the passage. On examining the lining of the tube, it was seen that the original white lining of Attaclay had been coated over by the yellowish bauxite during this passage. Following this, further samples of the mixture produced only a negative charge on the tube, the bauxite covering being maintained. At the end of these experiments, one coneful of pure Attaclay was blown through the tube with the result that the clay coated the bauxite and the dust was negatively charged.

When 5 volumes of Attaclay were mixed with one of bauxite, the lining of the tube was always composed of Attaclay, and the tube was always positively charged.

The effect of mixing bauxite with pyrophyllite was more pronounced than that with Attaclay. With 5 volumes of pyrophyllite to one of bauxite, passage of the first sample showed a rise, total decline, and final steady rise of the voltage of the tube, apparently accompanying an initial coating by pyrophyllite followed by adhesion of the bauxite to this foundation. The tube was negatively charged, and the visible part of the coating was bauxite at the end. In a volume ratio of one part of bauxite to 10 of pyrophyllite, only the pyrophyllite coated the tube, and the dust clouds were negative in charge.

The charging of the dust clouds could also be followed roughly by the fact that the positively charged clouds, whether of bauxite alone or of bauxite mixtures, were more dense and much more permanent than the negatively charged ones of Attaclay or pyrophyllite and their mixtures with bauxite.

When the blowing gas was admitted to the tube at higher space velocities of the order of 3 cu ft/min, the charging was low and erratic. This may have been due to difficulty in formation of the coating and disruption of the coating caused by the high velocity of the dust particles.

That bauxite adheres to surfaces composed of bauxite or other powders more readily than to metal was indicated by the adhesion tests. When the bauxite was blown onto the copper plate, heavy deposits would form, only to slide off on the slightest tapping. Furthermore, the tendency of the bauxite to cake and its resistance to flow reveal the strong adhesion of the bauxite particles to each other.

Frictional electrification processes such as described here are important because they are in widespread commercial use for the dispersion of dusts. Our observations add to the evidence that in these processes the charge separation is principally due to contact between the dielectric particles rather than to that between dielectric and metal (*2*, *5*, *7*).

The studies of the coating formed in the tube account especially for the fact observed by Rudge (*8*) and Wilson, Janes, and Campau (*10*) that the nature of the metal surface of the tube has no important effect in such frictional charging.

Böning (*1*) and Israel (*3*) observed that when a dielectric dust was blown against a rough surface of the same or other dielectrics, the dispersed particles became positively charged. A smooth dielectric surface caused negative charge. Our experiments are in accord with these, in that the bauxite coatings appeared rough, the clay and pyrophyllite linings smooth.

MacLeod and Smith (*6*), in work with separate powders, noticed that if the dust lining formed in the tube is allowed to accumulate to a considerable thickness, it reduces the difference in the total weights of the positively and negatively charged particles in the dust clouds formed.

Wilson, Janes, and Campau (*10*) report findings which, by their similarity to the effects we have found due to the coating process, can be ascribed to that phenomenon. They found that consistent results were obtained if the metal tube was cleaned only between changes in the materials studied, and that their slower-flowing materials required passage of a large number of samples for satisfactory charging records.

In conclusion, we note the possibility that the bauxite in the mixtures with Attaclay and pyrophyllite exerts at least part of its effect by coating over the individual parti-

cles of clay or pyrophyllite in the mixture so that the outer surface of a large fraction of the particles in the mixture would be composed of bauxite.

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The Effect of α-Tocopheryl Phosphate on Diphosphopyridine Nucleotidase

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We have previously reported (*2*) that the inhibition of E-deficient heart-muscle succinoxidase and the stimulation of lactic dehydrogenase from the same source by α-tocopheryl phosphate probably are best explained by the assumption that the compound (α-TPh) inhibits the enzyme diphosphopyridine nucleotidase (DPNase). The preservation of DPN thereby would produce inhibition of succinoxidase by the promotion of oxalacetate formation by the DPN-requiring malic dehydrogenase and would produce stimulation of lactic dehydrogenase, since this enzyme requires DPN.

Ames (*1*) recently has concurred that inhibition of succinoxidase by α-TPh is due to DPNase inhibition and has amplified this concept to show that α-TPh can form an insoluble salt with calcium, thus removing the latter ion so that it does not activate DPNase.

Neither our previous investigation nor that of Ames was based on direct measurements of DPNase activity in the presence of tocopherol. The present paper presents such data, which confirm the hypothesis.

Normal guinea pig hearts were homogenized in distilled water, a 10% suspension being used as a source of DPNase. Sodium-*dl*-α-tocopheryl phosphate was prepared by E. M. Schultz, of the Department of Organic Chemistry of this Division. DPN was prepared by the method of Williamson and Green (*5*) and was estimated in the reaction mixtures by the fluorometric method of Levitas, *et al.* (*3*).

The experiments were set up in 15-ml graduated centrifuge tubes, each of which contained 1 ml of M/5 phosphate buffer, pH 7.2, 0.5 ml of homogenate, and 0.5 ml of buffer containing 500γ of DPN. $CaCl_2$ and α-TPh were dissolved in water and added in the order described below. The volumes were made to 3.0 ml with distilled water. After completion of additions, the contents of the tubes were mixed, and the tubes were incubated at 37° for 0 time, 15, 30, and 45 min, and 1 hr, after which times the enzymes were inactivated by the addition of 0.2 ml of 20% trichloracetic acid. The incubation was carried out without stirring, in order to minimize solubility product effects. After filtration, the filtrates were analyzed for DPN, and the results were plotted against time.

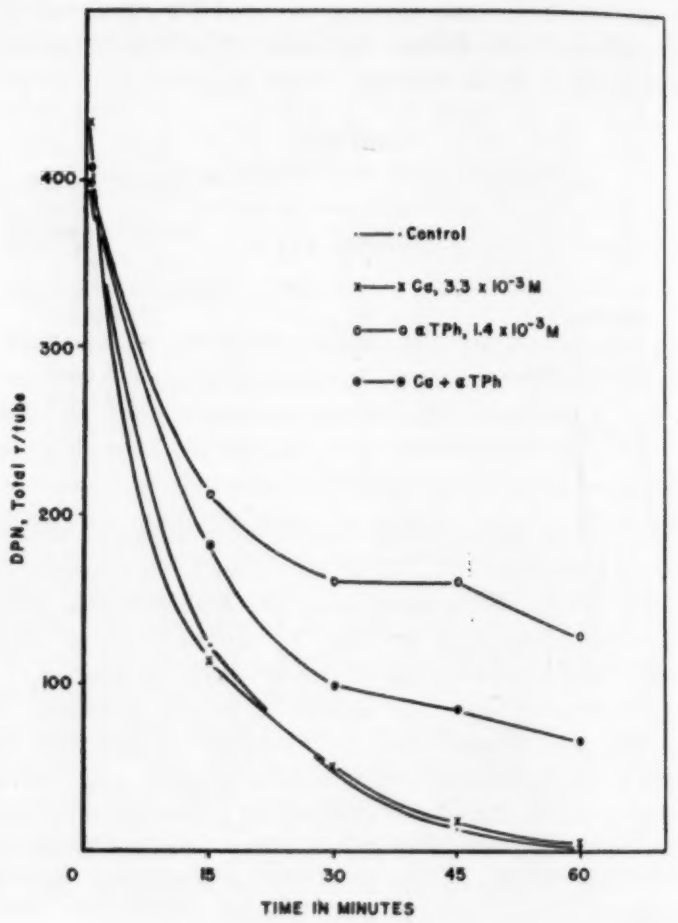

Fig. 1

Fig. 1 demonstrates that the rate of breakdown of DPN is inhibited markedly by α-TPh. In this experiment α-TPh was present in the concentration of 1.4×10^{-3} M and $CaCl_2$, 3.3×10^{-3} M. The calcium relieved the α-TPh inhibition but did not increase the rate of DPNase activity when α-TPh was not added. In view of the data of Ames (*1*), showing the effect of varying concentrations of α-TPh and of calcium on DPN breakdown, it was thought desirable to carry out experiments similar to his by the above techniques. Table 1 shows the results of such experiments. The data agree very well with those of Ames, as to the effect not only of varying concentrations but also of the order of addition of α-TPh and calcium. Percentage inhibition has been calculated on the basis of the 1-hr values.

The fact that calcium has less effect in relieving the tocopherol inhibition when added before the α-TPh is explained by Ames as being due to the removal of some of the calcium as calcium phosphate, thus allowing the α-TPh to remove the residual calcium more efficiently.

It would seem that another interpretation of these

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results would also be possible. If one examines the data with the hypothesis that α-TPh has a direct inhibitory action on DPNase, one might consider that, if calcium were partially removed by phosphate, there would be less residual calcium available to α-TPh, more α-TPh uncombined with calcium, and a resulting greater DPNase inhibition. Conversely, if α-TPh were added to the buffer first, followed by calcium, the α-TPh would compete with phosphate for calcium and thus would have a better chance of reacting with calcium ions; the precipitation of α-TPh would be more complete, and less DPNase inhibition would result. Consequently, the direct inhibition of DPNase by α-TPh seems to us to be a valid possibility.

TABLE 1

INHIBITION OF DPNASE BY α-TPH AND EFFECT OF CALCIUM*

		Calcium added before α-TPh			Calcium added after α-TPh	
Molarity of α-TPh		5.6×10^{-4}	1.4×10^{-3}	2.8×10^{-3}	1.4×10^{-3}	2.8×10^{-3}
Molarity of $CaCl_2$	0	1.0	26.1	42.7	28.8	54.1
	3.3×10^{-4}	1.0	28.7		26.4	
	3.3×10^{-3}		15.5	41.4	3.5	8.8
	3.3×10^{-2}		10.0		4.0	

* Figures represent percentage inhibition of DPNase.

In the great majority of these experiments (10 out of 11) the addition of calcium to the control tubes, without α-TPh, produced no acceleration of DPN breakdown in the time intervals used. Swingle, *et al.* (*4*) have reported activation of DPNase in rat liver by calcium in experiments of 20-min duration. Since our first readings were made at 15 min, we may have failed to see the phenomenon. Of course, it is possible that heart-muscle DPNase does not require calcium for activation or, more probably, that sufficient calcium already is present. However, experiments using washed homogenates showed a great decrease in DPNase activity but no activation of the DPNase remaining was observed following the addition of calcium.

In conclusion, it may be said that α-tocopheryl phosphate has been shown by direct DPN estimation to inhibit DPNase. The observations of Ames that calcium relieves this inhibition have been confirmed. In our opinion, there are still bases for the possibility that α-TPh has a direct inhibitory effect on DPNase.

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The Sex of the Host as a Factor in *Plasmodium gallinaceum* Infections in Young Chicks

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In chicks inoculated with *P. gallinaceum* Brumpt, the percentage of parasitized erythrocytes, the rate of endothelial invasion, and the therapeutic efficacy of quinine have been observed to differ significantly with the sex of the host.

Fourth-day parasite counts[1] were accumulated on 449 White Rock chicks inoculated at 6–8 days of age with

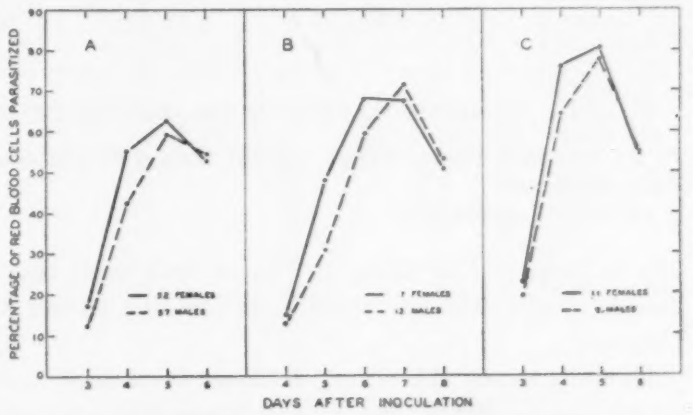

FIG. 1. Average daily parasite counts of male and female chicks infected with *P. gallinaceum*: (A) 109 White Rock chicks inoculated at 8 days of age with 16×10^6 parasitized red cells; (B) 20 White Rock chicks inoculated at 8 days of age with 1,000,000 parasitized red cells; (C) 20 Rhode Island Red chicks inoculated at 7 days of age with 16×10^6 parasitized red cells.

16×10^6 parasitized red cells (*1*). Analysis by sex showed that for 222 females the counts averaged 62.3% (S.E. = 1.2), whereas for 227 males the counts averaged 53.8% (S.E. = 1.2). Comparable sex differences were also found in the daily parasite counts in two different breeds of infected chicks (Fig. 1).

To determine whether the sex difference in parasite counts could be experimentally increased, male and female sex hormones of proven activity in chicks (*6*) were administered. Ninety infected chicks were divided into 3 equal groups. Each chick in group A was injected intramuscularly with 0.1 mg of testosterone propionate in 0.1 cc of corn oil daily for 6 days, beginning on the day before the inoculation. Chicks in group B were similarly injected with 0.1 mg of α-estradiol benzoate, and each of the controls in group C received 0.1 cc of corn oil alone daily for the same period. The difference in parasite counts in the two sexes was not significantly increased by the administration of male or female sex hormones under the conditions of these experiments.

[1] Smears of peripheral blood were air dried, fixed with methyl alcohol, and stained with Giemsa. When the parasite count was 30% and above, it was obtained by counting the parasitized cells in 100 erythrocytes. When lower counts were found, the number of erythrocytes examined was increased so that the probable error remained under 10% (*4*).

The incidence of exoerythrocytic schizonts (*5*) in the capillary endothelium of the brain of chicks examined (*2*) at various intervals after inoculation of sporozoites (*3*) is presented in Table 1. These data show that the female chicks evidence endothelial invasion earlier than the males.

TABLE 1

INCIDENCE OF EXOERYTHROCYTIC SCHIZONTS IN THE CAPILLARY ENDOTHELIUM OF THE BRAIN OF CHICKS EXAMINED 6–12 DAYS AFTER THE INTRAMUSCULAR INJECTION OF SPOROZOITES OF *P. gallinaceum*

	6th–10th day		11th day		12th day	
	No. examined	% positive	No. examined	% positive	No. examined	% positive
Females	61	65.6	41	90.2	40	92.5
Males	67	43.3	55	69.1	57	91.2
$\frac{\text{diff.}}{\text{S.E.}_{\text{diff.}}}$*		2.59		2.71		NS†

* $\frac{\text{diff.}}{\text{S.E.}_{\text{diff.}}}$ represents the ratio of the observed difference to its Standard Error. Values greater than 2.00 are considered significant.

† NS = not significant.

Parasite-count differences between the males and females were observed also in 418 blood-inoculated chicks treated with a suppressive level of quinine hydrochloride (Table 2). It should be noted further that, of the 20 chicks in this group that showed a parasite count of 30% and above (*i.e.* therapeutic failures or "breakthroughs"), 15 were females.

TABLE 2

FOURTH-DAY PARASITE COUNTS OF INFECTED CHICKS* TREATED WITH QUININE†

	No. treated	Average count	Chicks showing count of 30% and above	
			No.	%
Females	212	7.28%	15	7.1%
Males	206	4.60%	5	2.4%
$\frac{\text{diff.}}{\text{S.E.}_{\text{diff.}}}$		2.55		2.3

* All chicks received 16×10^6 parasitized red cells on the 7th or 8th day of life.

† 0.02 mg quinine hydrochloride/gm of body weight was given by capsule twice daily for 4 days, starting on the day of inoculation.

Thus, statistical analysis of the infections of young chicks inoculated with *P. gallinaceum* revealed significant differences attributable to the sex of the host. As compared with the males, the female chicks showed higher parasite counts, experienced earlier endothelial invasion, and were less effectively protected by quinine. Treatment with male and female sex hormones under the conditions specified did not increase the difference between the average parasite counts in the two sexes.

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The Effect of Relative Concentration on Complement Fixation by Identical Amounts of Antigen and Antibody

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In the course of attempts to standardize influenza virus A or B antigens it was noted that there was sometimes considerable variation in the amount of complement fixed by two antigens prepared from the same strain by identical methods and titrated together in the same test. Investigation revealed the variation to be due to the fact that equivalent amounts of the same antiserum and antigen fix different amounts of complement when they are mixed at different volumes, even when the volumes are quickly equalized by the addition of appropriate amounts of saline. The phenomenon was also observed with soluble pneumococcus polysaccharides and their respective antisera, and, using these systems, it was found that there is an optimum volume, at which a maximum amount of complement is fixed, for given constant amounts of antibody and antigen. To show that this is true at several antigen-antibody ratios is the purpose of this preliminary report.

The technic employed was that of Rice (*13*). Experience brought out the necessity of taking pains in pipetting. To 0.05 ml of diluted pneumococcus type-32 rabbit antiserum[1] was added 0.10 ml of complement containing six 50% units, three different doses of purified (*1*) type-32 polysaccharide[2] solution in varying volumes of different dilutions, and sufficient 0.85% NaCl solution to make a total volume in each tube of 0.30 ml (Table 1). The reagents were added in the order given. The time which elapsed between the addition of the antigen and the adjustment of total volume to equality by the addition of saline was 5–10 min. After incubation at 3°–6° C for 24 hrs, 0.2 ml of sensitized sheep red blood cells was pipetted into each tube and the mixtures incubated at 37° C for exactly 15 min. The degree of hemolysis was read immediately by comparison with a color standard,

1 We wish to thank Miss Gretchen R. Sickles for the antiserum.

2 We are grateful to Dr. Rachel Brown for the purified pneumococcus polysaccharide.

according to the methods of this Division (*14*). Appropriate serum, antigen, complement, and cell controls were included and showed that nonspecific reactions did not occur.

TABLE 1

EFFECT OF RELATIVE CONCENTRATION OF ANTIGEN ON AMOUNT OF COMPLEMENT FIXED BY IDENTICAL AMOUNTS OF ANTIGEN AND ANTISERUM*

Antigen			Saline	Serum dilution (0.05 ml)				
Dose (γ)	Dilution	Amount pipetted (ml)	Amount pipetted (ml)	1:1,000	1:1,100	1:1,200	1:1,300	1:1,400
				Hemolysis (%)				
0.05	1:400,000	0.02	0.13	70	80	85	95	100
	1:800,000	0.04	0.11	65	75	80	90	100
	1:1,000,000	0.05	0.10	60	70	75	85	100
	1:1,200,000	0.06	0.09	50	60	70	80	100
	1:1,400,000	0.07	0.08	45	55	65	75	100
	1:1,600,000	**0.08**	0.07	**40**	**50**	**55**	**65**	**100**
	1:1,800,000	0.09	0.06	55	60	70	80	100
	1:2,000,000	0.10	0.05	60	80	85	85	100
	1:2,400,000	0.12	0.03	65	85	90	90	100
	1:3,000,000	0.15	0	70	90	95	100	100
0.02	1:1,000,000	0.02	0.13	55	65	75	90	95
	1:1,500,000	0.03	0.12	50	60	70	85	90
	1:2,000,000	0.04	0.11	45	55	60	80	85
	1:2,400,000	0.05	0.10	40	50	55	75	80
	1:3,000,000	**0.06**	0.09	**35**	**40**	**45**	**70**	**75**
	1:4,000,000	0.08	0.07	45	50	55	75	80
	1:5,000,000	0.10	0.05	50	55	65	80	85
	1:6,000,000	0.12	0.03	55	60	75	85	95
	1:7,000,000	0.14	0.01	65	70	80	90	100
	1:7,500,000	0.15	0	70	75	85	95	100
0.01	1:3,000,000	0.03	0.12	100	100	100	100	100
	1:4,000,000	0.04	0.11	95	100	100	100	100
	1:5,000,000	0.05	0.10	90	95	100	100	100
	1:6,000,000	**0.06**	0.09	**70**	**65**	**100**	**100**	**100**
	1:7,000,000	0.07	0.08	75	85	100	100	100
	1:8,000,000	0.08	0.07	80	90	100	100	100
	1:9,000,000	0.09	0.06	85	95	100	100	100
	1:10,000,000	0.10	0.05	90	100	100	100	100
	1:12,000,000	0.12	0.03	95	100	100	100	100
	1:13,000,000	0.13	0.02	100	100	100	100	100
	1:14,000,000	0.14	0.01	100	100	100	100	100
	1:15,000,000	0.15	0	100	100	100	100	100

* Six 50% units of complement (in 0.10 ml) were used throughout.

The amount of complement fixed, as measured by per cent hemolysis, increased regularly to an optimum point, then similarly decreased, depending on the relative concentration at which constant amounts of antigen and antibody first came into contact (Table 1). Hemolysis was minimal in each tube which received 0.08 ml of a 1:1,600,000 dilution (0.05γ), 0.06 ml of a 1:3,000,000 dilution (0.02γ), and 0.06 ml of a 1:6,000,000 dilution (0.01γ). With these reagents, therefore, the most complement was fixed when the reagents were first mixed in a total volume of approximately 0.21–0.23 ml, and this condition is a characteristic of the reaction in addition to the optimum antigen-antibody proportion of Dean (*3*). From these data, the optimum amount of antigen for the antiserum range tested was 0.02γ.

The tubes containing a given amount of antibody and polysaccharide antigen (in γ) differed from one another in no respect except that serum, complement, and antigen were mixed at different volumes, and this difference was eliminated within 5–10 min when the volumes were rectified by the addition of saline. The phenomenon is therefore unlikely to be due to variation of one reagent, nor is it likely to involve complement in the brief period during which volumes are unequal, since fixation of complement is comparatively slow. Antigen-antibody reactions, however, are rapid (*5*), the size of antigen-antibody aggregates is a factor influencing the amount of complement fixed (*2, 4*), and the relative concentration of antigen and antibody is a factor determining the composition of precipitates (*6*) and amount and visibility (*7, 8, 12*) of precipitates. An hypothesis to explain the effect might be built on this basis, assuming that the size of the aggregates varied with composition and amount. An analogous effect has been observed with gold sols, the relative concentration in which reagents are mixed modifying the degree of coagulation of the sol (*9*).

The phenomenon has been elicited regularly with several preparations of pneumococcus polysaccharides and, as mentioned above, with influenza virus A and B antigens prepared by various technics. It has not yet been

demonstrated with cardiolipin antigen (*10, 11*), since sufficiently accurate replicate dilutions could not be prepared from the concentrated antigen, and it is known that adding saline to a dilution already made up will alter the properties of a lipid antigen. It seems reasonable, however, to expect that it can be detected in complement-fixation tests with a wide variety of antigens. Studies of the further characteristics of the reaction and its application to the standardization of antigens will be presented in greater detail elsewhere.

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Effect of Low Temperatures on the Germination of Inbred Lines of Sweet Corn

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Commercial seed corn producers have for some time been using cold-room tests as indicators of the cold hardiness of their inbred lines of seed corn and to see how well they can withstand the attacks of soil pathogens under poor conditions for germination. Usually the seeds are sown in soil taken from a near-by cornfield known to contain plenty of detrimental soil organisms. They are then placed in a 50° F room for a given length of time (usually 8 days), after which they are removed to a warm room so that the uninjured seeds may germinate. The percentage germination, measured by plumule appearance above soil level, gives an estimate of the hardiness of the lines.

In order to test whether such conditions could be applied to inbred sweet corn, 5 Connecticut lines of inbred sweet corn, viz., C4, C40, P51, T51, and C95, were obtained from W. R. Singleton and sown in flats containing soil from a field recently under corn. Each flat contained 50 seeds of each inbred for each test. One series of flats was placed in a 40° F cold room and the other in a 50° F room, the soil being kept moist by watering when necessary. After definite intervals in the cold, a flat from each room was removed to a warm greenhouse and the resulting germination of each inbred line determined.

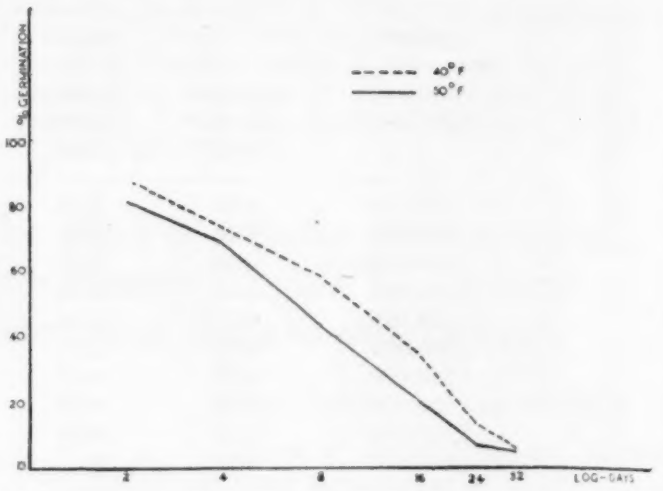

Fig. 1. The effect of cold room treatments on the subsequent mean percentage germination of 5 inbred lines of sweet corn.

The mean percentage germination of all the inbreds for each treatment was calculated and plotted against the logarithm of time of treatment. It is seen from Fig. 1 that germination drops off with increase of duration in the cold prior to plumule emergence, and that the 40° F treatment does not reduce germination as much as does 50° F. As the mean percentage germination of inbred lines in the control flat placed directly after sowing in the warm greenhouse was 84.8%, it appears from the graph that 8 days at 50° F are necessary to obtain a diminution of 50% in germination. Although this is the set of conditions commonly used by the corn companies for their estimates, it would seem that, for a more critical evaluation, a mean percentage germination of 35% is indicated. This would require 10 days in the cold room. In general, then, the empirical tests of the corn companies fit in well with the laboratory tests for the sweet corn inbred lines.

The difference between the effects of the 40° and 50° temperatures for equivalent lengths of treatment suggests that the causes of loss of germination are in part due to damage of the seed from cold during germination and in part to damage by the penetrating soil pathogens acting on the weakened seedling; these organisms are themselves partially inhibited at the lower temperature. The 40° room thus gives a truer picture of resistance of the inbreds to direct damage by cold. When using the above experimental conditions as a laboratory method for selecting cold hardy corn lines, the 50° room is preferable, for not only is it more critical, but there is selection of lines resistant to several different types of detrimental influences.

Further investigations on this aspect of cold treatment of sweet corn are now being made with funds provided by the Agricultural Research Council of Great Britain.

IN THE LABORATORY

The Solubility of Progesterone in Saline[1]

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The mode of transport of the steroid hormones of the ovary, the testis, and the adrenal in the blood has been held to be a not inconsiderable problem, inasmuch as these compounds are generally regarded as insoluble in water, and blood is essentially an aqueous medium. The problem is perhaps most striking with respect to the luteal hormone, progesterone, which is probably the least active of the glandular steroid hormones, the international unit being 1.0 mg. Few precise measurements of the solubility of steroid hormones in water appear to have been made, however, and the data on the concentrations of these hormones in circulating blood are not entirely satisfactory.

Using a bioassay procedure that regularly detects 0.0002 μg of progesterone (*1*) it has been found that random samples of blood plasma from pseudopregnant rabbits, pregnant mice, a pregnant woman, and a monkey in the luteal phase of the menstrual cycle contained 5.5–8.0 μg of progesterone/ml. Approximately 90% of the hormone was biologically active without fractionation and was readily extracted with ether or acetone. The remaining approximately 10% appeared to be bound to protein and showed no activity until freed by partial hydrolysis with acid. The most frequently observed level, 6.0 μg, of "free" progesterone is equivalent to 0.0006 gm/100 ml, a ratio that would ordinarily be considered to represent insolubility. Accordingly, attempts have been made to ascertain the solubility of crystalline progesterone in 0.9% NaCl solution. Saline rather than distilled water was chosen to simulate the ionic concentration of the blood and to provide an isotonic material for injection.

As a first test, an excess of progesterone was placed in each of three flasks, and approximately 100 ml of 0.9% saline was added. One flask was stored at room temperature, the second at 37° C, and the third at 59° C. The flasks were allowed to stand with occasional shaking for 24 hrs. At the end of this time a sample was drawn from the supernatant fluid in each flask and immediately assayed by intrauterine injection into ovariectomized mice according to our regular procedure (*1*). The sample stored at room temperature assayed 0.5 μg/ml; the sample at 37° C, 6.0 μg/ml; and the sample at 59° C, slightly more than 6.0, but less than 6.6 μg/ml.

To test the validity of assay of progesterone in aqueous solutions, two solutions of progesterone were prepared at 37° C and assayed. The first was made to contain 3.0 mg/liter (3.0 μg/ml), and the second, 6.0 mg/liter (6.0 μg/ml). The assay values were 3.0 and 6.0 μg/ml, respectively.

Two attempts were made to determine solubility at 37° C gravimetrically as well as by bioassay. In the first, 15.0 mg of crystalline progesterone was placed in a 1-liter volumetric flask that was then filled to mark with 0.9% aqueous NaCl. The flask was placed in the incubator at 37° C and stirred mechanically for 16 hrs. After an additional 8 hrs in the incubator, the fluid was filtered through a Gooch crucible to determine the quantity of undissolved progesterone. This was found to be 8.4 mg, indicating that 6.6 mg had dissolved. A small portion of the filtrate was assayed, with a finding of 6.0 μg/ml. Efforts to obtain a satisfactory value for the weight of the evaporated filtrate were unsuccessful. In the second determination the same procedure was followed except that 10.0 mg of progesterone was the starting quantity, the storage period was 30 days, and the agitation was occasional and by hand. Here the material retained by the Gooch funnel was 1.0 mg, indicating that 9.0 mg had dissolved. The filtrate assayed slightly more than 8.0 μg/ml. Again, a satisfactory value for the weight of the evaporated filtrate was not obtained. The agreement in both determinations between bioassay and the partial gravimetric determination seems to be reasonably good.

Apparently the solubility of crystalline progesterone in saline at 37° C is approximately 6.0–9.0 μg/ml, or 6.0–9.0 mg/liter. The solubility at room temperature is clearly much less, and increasing the temperature above 37° C did not significantly increase the quantity dissolved. It is not apparent why storage for 30 days appreciably increased the amount dissolved over that in solution at the end of 24 hrs.

Although the data on plasma levels include but a few physiologic states, no level of "free" progesterone thus far encountered exceeds the solubility of this compound in water (saline) at body temperature. If this circumstance obtains after further study, it may prove unnecessary to postulate any device other than physical solution in water for the transport of the biologically active progesterone in the blood.

[1] This investigation was aided by grants from the Committee for Research in Problems of Sex, National Research Council, and from the Fluid Research Fund of the Yale University School of Medicine.

The progesterone was supplied by Ciba Pharmaceutical Products, Inc., through the courtesy of Ernst Oppenheimer and F. L. Mohr.

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A Simplified Procedure for Breaking Diapause in Grasshopper Eggs

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In a recent article (*1*) a method for breaking diapause in eggs of the grasshopper, *Melanoplus differentialis,* was described. The greater part of the chorion was removed with sodium hypochlorite from eggs which had been in diapause for several weeks. After careful washing and drying, the eggs were then treated for ½ hr with xylol. A simpler method for accomplishing the same purpose, and one in which no sodium hypochlorite is used, has now been devised. As would be expected, there is less spoilage than with the earlier method, for the eggs are exposed to a single toxic material instead of to two.

In this modified procedure the eggs,[1] with the chorion intact, are dried thoroughly and placed in a dish of xylol. Under a dissecting microscope each egg is then grasped lightly near its middle between the tips of a pair of forceps, and pressure just sufficient to crack the chorion is applied. Scarcely more than a touch is required to do this, for the chorion—providing the eggs have been dried properly beforehand—becomes extremely brittle in xylol. Following this, each egg, if grasped gently near one end, will usually slip out of its chorion. If this does not occur readily, the crack in the chorion may be enlarged with a needle. The actual procedure is easier to carry out than to describe.

After its removal from the chorion, each egg, still encased in its tough, resistant, and transparent chitinous cuticle, is transferred to another dish of xylol and allowed to remain there for 30 min. Recent experiments indicate that a shorter exposure may be sufficient, but one of 30 min does no apparent harm. Next, the eggs are removed from the xylol and dried rapidly on several changes of filter paper. They are then placed in a Petri dish on another piece of filter paper which has been soaked with distilled water.[2] During the first 24 hrs or so of incubation at 25° C, enough fluid is left in the dish so that the hydropyle of each egg is just submerged. Most of the liquid is then drained off and the filter paper kept only slightly dampened during the rest of the incubation period. If too little moisture is supplied, the eggs will not start to develop, and if too much is given, they will burst.

During the first day following treatment with xylol the eggs absorb water and increase markedly in size. At the same time the embryos, which during diapause have a dense, opaque, whitish appearance, enlarge and become noticeably more transparent. This is due, no doubt, to the uptake by their cells of a portion of the water which has just entered the egg. Soon the lateral body walls of the embryos begin to show rhythmic contractions, and on the third or fourth day the first eggs undergo blastokinesis. Hatching begins from 15 to 17 days later. If the amount of water surrounding the eggs has been properly controlled, all or a very high percentage of the eggs may be expected to hatch.

[1] Each egg is first examined in water and with a dissecting microscope to be certain that it is in good condition and that it contains an embryo with partially pigmented eyes.

[2] If molds cause trouble, 0.15% Moldex solution may be used in place of water.

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A Rapid Method for Celloidin Impregnation of Undecalcified Bone[1]

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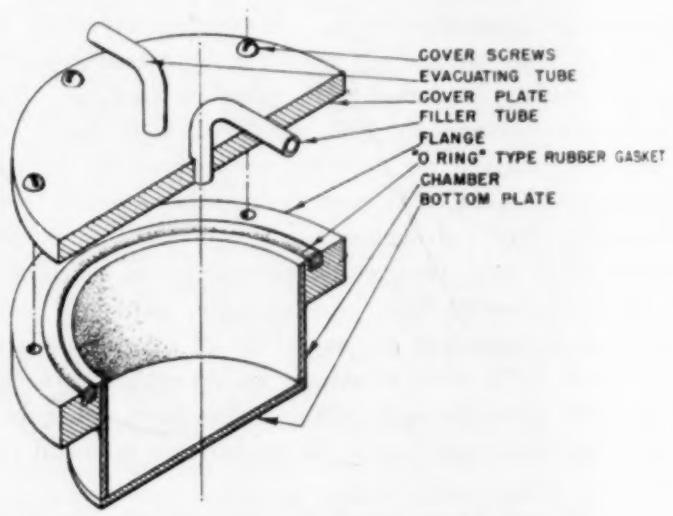
While working with Au^{198}, which has a half-life of 2.7 days, great difficulty was experienced in obtaining autoradiographs of bone because of its relatively rapid rate of decay. Routine celloidin embedding of bone (undecalcified) requires 7–10 days, which made it impractical to obtain autoradiographs if tracer conditions were to be maintained. For these reasons the following method was developed.

The bone specimen was placed in the embedding dish and enclosed in the apparatus as pictured (Fig. 1). A



BONE SPECIMEN IMPREGNATING BOMB

FIG. 1

vacuum of 5 mm Hg was obtained with a Hivac air pump and continued for 60 min. Celloidin was then introduced by means of the negative pressure, flowing through the central inlet and into the dish. Pressure was then applied (15 lbs.) overnight.

By this method satisfactory embedding was secured and excellent undecalcified 4-μ sections of bone were made.

[1] This work was supported by a grant from the John and Mary R. Markle Foundation.

Book Reviews

The psychology of ego-involvements: social attitudes & identifications. Muzafer Sherif and Hadley Cantril. New York: John Wiley; London: Chapman & Hall, 1947. Pp. viii + 525. $6.00.

Two able social psychologists combine their talents to present a systematic development of the concept of ego-involvement, a problem which deserves much more attention than academic psychology has seen fit to accord it.

Regarding the ego as a constellation of attitudes which, from infancy on, are related to the "I," "me," "mine" experiences, the authors first provide a careful consideration of the concept of attitude. Significant is a constant effort to correlate everyday human phenomena with results from the laboratory. Rejecting any notion that the ego is an innate entity, considerable attention is given to its genetic development, for, as attitudes are learned (and they are learned), the ego is formed. Of especial importance is the turbulent period of adolescence, during which there is a "re-formation" of the ego which "has to be anchored securely and in a relatively high standing in relation to one's group. Whether this will be achieved by being assertive or submissive, by being individualistic or co-operative . . . will vary according to the demands and pressures of one's own reference group in general and membership group in particular" (p. 277). One sees here the repeated emphasis of the book in stressing the impact of the social environment on the development of the individual.

In rounding out their thesis, the authors range widely in gathering evidence from the fields of anthropology, delinquency and gang behavior, industry, the military, mental disorder, literature, and conclude with a belaboring of psychoanalysis; but at no time do they depart from a close correlation of all data with their systematic formulation.

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Colloid science, a symposium. E. K. Rideal, *et al.* Brooklyn, N. Y.: Chemical Publishing Co., 1947. Pp. x + 208. (Illustrated.) $6.00.

Based on a postgraduate course sponsored by the Department of Colloid Science, Cambridge University, this book deals with the following chapters: "Surface Chemistry and Colloids" (insoluble monolayers; multilayers; foams; emulsions; the solid-liquid interface; electrokinetic phenomena; colloidal electrolytes) (52 pp.), "Thermodynamics and Colloidal Systems" (15 pp.), "The Study of Macromolecules by Ultracentrifuge Electrophoresis, and Diffusion Measurements" (15 pp.), "The Viscosity of Macromolecules in Solution" (37 pp.), "The Kinetic Theory of High Elasticity" (8 pp.), "Emulsions *in vivo*" (11 pp.), "The Study of Colloidal Systems by X-Ray Analysis" (15 pp.), "Membrane Equilibrium" (8 pp.), "Infra-red Spectra and Colloids" (8 pp.), and "Vinyl Polymerization in the Liquid Phase" (19 pp.).

This formidable array of topics is treated in the space of 188 small pages. Except in the case of an article by Eirich on the viscosity macromolecules in solution, this limitation has led to an excessively condensed and rather sketchy presentation, however able and competent the various authors are.

Those familiar with the subject matter are hardly in need of reviews of this nature; much more thorough and scholarly treatments are readily available. Those not yet intimately familiar with the subject matter will hardly be able to obtain more than the most superficial instruction. The book will be of value primarily to those who happened to attend the symposium on which the book is based.

As a sign of the postwar resurrection of constructive scientific interest in Great Britain, the book is highly welcome; very few, however, will find it profitable to purchase this excessively high-priced book.

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Multiple factor analysis: a development and expansion of "The vectors of mind." L. L. Thurstone. Chicago: Univ. Chicago Press, 1947. Pp. xix + 535. (Illustrated.) $7.50.

Since the early '30s many psychologists have recognized factor analysis as the most promising research tool for systematizing the chaos in the measurement of mental aptitudes and personality. It provides a statistical method for seeking the functional unities which could account for the complexly determined abilities, traits, and responses of human subjects. Dr. Thurstone and his colleagues developed a matrix formulation of the factor problem which is general enough to be applicable in many young fields of research such as learning, perception, aesthetics, social behavior, political science, meteorology, and public health. Enthusiasm for the method was accompanied by misinterpretations and by criticisms of the arbitrariness of alternate solutions.

To clarify the issues, Dr. Thurstone has expanded this revised treatise to double the size of *The vectors of mind* (1935). The lucid mathematical introduction to matrix theory remains as a great aid to the student. Fundamental factor problems are then discussed in detail, with geometrical models to aid the understanding of configuration, rotation of reference axes, and relations between hyperplane and cluster solutions.

A variety of factoring techniques are derived, and the computations illustrated with box problems to simplify discussion of the factors obtained from alternate solutions. This reveals the advantages and limitations of

the diagonal, grouping, bi-factor, centroid, and principal axes methods. Thurstone's preference is for the centroid method with subsequent rotation of axes to give simple structure, in terms of either correlated or independent factors.

Dr. Thurstone considers the question of sampling errors to be petty relative to the major conceptual problems. He now makes clear his conception of factor analysis, *not* as a method for statistical prediction of individual scores, but rather as a research method for refining and testing hypotheses about functional unities. Invariance of factor structure is thus more essential than invariance of factor loadings, which are altered by selection of variates.

The newly recognized study of second-order factors derived from first-order factors is cleverly illustrated and gives promise as a method of verifying hierarchies of generating influences.

Although there is no bibliography and little attempt to relate the discussion to other literature in the field, the neophyte will find clear guidance, and the experienced factorist will find provocative clarification of major issues concerning the uses of this versatile, though imperfect, research tool.

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Scientific Book Register

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